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II. Muddy Creek Drainage Basin, Cincinnati, Ohio

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16. ABSTRACT

This report represents the initiation of a program to determine the types of sources of priority pollutants and the magnitude of their contribution to publicly owned treatments works (POTW). The initial phase, described in this report, is designed to study the non-heavy industry contributors. Thus, residential, commercial and light industry-type sources have been identified as those of primary interest.

The complete study is to be carried out in phases and this report describes the results of the first phase of the program which was designed to develop a general approach, obtain background information, test alternative procedures and develop the basis for detailed planning of the full study.

A detailed quality control program was implemented for this study. A total of 69 composite samples were collected for the generation of 140 samples for analysis, the increment coming from the quality control program. Samples were analyzed for all 129 priority pollutants (excluding asbestos) plus manganese and the classical parameters of pH, TEMP, TSS, TOC, BOD, COD, ammonia, oil and grease.

Approximately 20 organic species were detected in the POTW influent and sewer samples, mostly at concentrations near the detection limit. Only several organic species were found above 10 mg/l, namely chloroform and other halomethanes, phenol, toluene and naphthalene (each at one sewer site) and three phthalates.

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A given sample location has about the same number and concentration of priority pollutants from day to day.

New residential and hospital sites do not contain many priority pollutants other than those in tap water but seem to be good sources of copper.

SOURCES OF TOXIC POLLUTANTS FOUND IN INFLUENTS TO SEWAGE TREATMENT PLANTS

II. MUDDY CREEK DRAINAGE BASIN, CINCINNATI, OHIO

Final Report On
Task Order No. 6
EPA Contract No. 68-01-3857

by
P. Levins, J. Adams, P. Brenner, S. Coons, K. Thrun, A. Wechsler

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We wish particularly to thank the large number of Arthur D. Little, Inc. staff members who participated in the sampling and analysis team efforts. Their commitment to the program and their extra hours effort helped make the study a success. The willing cooperation of the corporate facilities staff also helped considerably with the intense start up effort required for this study.

I. SUMMARY

A. Introduction

This report represents the initiation of a program to determine the types of sources of priority pollutants and the magnitude of their contribution to publicly owned treatment works (POTW). The initial phase, described in this report, is designed to study the non-heavy industry contributors. Thus, residential, commercial and light industry-type sources have been identified as those of primary interest.

The complete study is to be carried out in phases and this report describes the results of the first phase of the program which was designed to develop a general approach, obtain background information, test alternative procedures and develop the basis for detailed planning of the full study.

B. Study

The literature was reviewed for general pollutant and priority pollutant information in sewers and POTWs. The search revealed the following information:

The majority of the data on priority pollutants in wastewater reported in the literature is for metals. An extensive data base exists for cadmium, copper, chromium, nickel and zinc; moderate data base for arsenic, lead and mercury; and limited data exist for selenium, beryllium, silver and thallium. Most data are reported for POTW influent samples, with little characterization of sources.

Three studies suggest that domestic sources contribute the following percentages of metal priority pollutants: cadmium, 10-70%; chromium, 3-40%; copper, 16-85%; lead, 13-60%; nickel, 10-55%; and zinc, about 30%.

Several studies indicate that runoff is also an important contributor to the level of metal pollutants.

Data were found in the literature on 31 of the 114 organic priority pollutants. Those in highest concentrations were chloroform, halomethanes, chloroethanes, ethyl benzene, and toluene. Good information on residential, industrial or other sources of organics was not found.

Samples of tap water, POTW influent and samples from six source locations (sewers) were collected throughout the Muddy Creek treatment area in Cincinnati.

Source locations included:

- New residential - sanitary sewer
- Old residential - combined sewer
- Residential/commercial - sanitary sewer
- Residential/commercial/light industrial - combined sewer
- Residential/light industrial - combined sewer
- Hospital - sanitary sewer

A detailed quality control program was implemented for this study. A total of 69 composite samples were collected for the generation of 140 samples for analysis, the increment coming from the quality control program. Samples were analyzed for all 129 priority pollutants (excluding asbestos) plus manganese and the classical parameters of pH, TEMP, TSS, TOC, BOD, COD, ammonia, oil and grease.

C. Principal Results in Muddy Creek

- Approximately 20 organic species were detected in the POTW influent and sewer samples, mostly at concentrations near the detection limit. Only several organic species were found above 10 µg/L, namely chloroform and other halomethanes, phenol, toluene and naphthalene (each at one sewer site) and three phthalates.

- Among pesticides, only heptachlor was found in three samples at about 1µg/L.

- All priority pollutant metals were found at least once except beryllium; only copper, manganese and zinc were found often at levels greater than 100 µg/L.

- A given sample location has about the same number and concentration of priority pollutants from day to day.

- New residential and hospital sites do not contain many priority pollutants other than those in tap water but seem to be good sources of copper.

- Chloroform concentration was highest in tap water and is reduced by a factor of 10 in the sewers. Bromomethanes and phenols seem to react, volatilize, or become diluted below the detection limits.

- Phthalates in sewers and POTW influent are at least partially accounted for by their presence in tap water.

- Except as mentioned below, the sources measured account reasonably well for all species detected at the POTW.

- Chromium, cyanides, and benzene were found in the POTW influent at levels not well accounted for by the sources sampled, implying their presence in zones other than those sampled.

- Apparent spills or leaks of gasoline or hydrocarbons were detected in one location on one day.

The quality control program demonstrated that the EPA Screening Methodology is capable of generating quite reliable data, when a quality control is used. The overall results of precision and accuracy studies of clean water reference samples and raw wastewater are summarized below by analysis category:

	Spike Concentration	Method Reference			Raw Wastewater		
	µg/L	$\bar{P}$		Sp	$\bar{P}$		Sp
Purgeables (VOA)	20	87	±	23	80	±	31
Acids	50	89	±	26	95	±	22
Base/Neutrals	50	100	±	33	84	±	25
Pesticides	30	73	±	11	69	±	14
Metals	10	115	±	71	NA*	±	17%
Total Cyanides	20	103	±	3	101	±	12
Total Phenols	60	107	±	13	93	±	15

Notes: $\bar{P}$ = percent recovery

Sp= standard deviation of percent recovery

*Recovery values for the metals cannot be determined since the samples were spiked at values equal to or less than the actual detection limits. However, using an alternative procedure (described in Section VII), the precision of the metals analysis can be determined.

There were some problems encountered with a few of the priority pollutants as stated below:

- Some of the more volatile compounds, i.e., chloromethane, bromomethane, vinyl chloride and dichlorodifluoromethane, apparently break through the Tenax/Silica Gel Trap during the recommended Purge and Trap procedure. Breakthrough was also observed with chloroethane in the analysis of samples from Trip I.

- Methylene Chloride data were erratic due to probable contamination. Therefore, they have been included in the data tables, but the averages have not been presented in the summary tables.

- Total phenol results for the samples collected on the first and second trips to the Cincinnati POTW were essentially the same. It is suspected that this method may be measuring a contaminant, rather than total phenols since the total phenol values do not agree with the phenol values as detected by GC/MS. Phenol itself only occurs in about one-third of the samples.

II. INTRODUCTION

A. Background

The Office of Water Planning and Standards (OWPS) is engaged in a concerted effort to develop a comprehensive regulatory strategy for controlling toxic pollutants introduced into, and possibly interfering with, publicly-owned sewage treatment works (POTWs). This effort by OWPS is focused on:

(1) The POTW treatment process,

(2) The sources of toxic pollutants to the POTW, and

(3) The best regulatory control strategy to achieve desired POTW wastewater effluent water quality standards.

The Monitoring and Data Support Division (MDSD), OWPS, has the responsibility of determining the sources and extent of toxic pollutants which enter POTWs (goal (2) above). Knowledge of pollutant sources and quantities, when combined with information from other EPA programs on industrial effluents and on operational characteristics and effectiveness of POTWs, is essential to the development of a rational control strategy for priority pollutants which may enter the environment through POTWs. This report is concerned with the initial study of sources of toxic pollutants found in POTWs in furtherance of goal (2) above.

Sources of toxic pollutants to POTWs include discharges from industrial and commercial establishments, domestic or residential sewage, stormwater runoff, and infiltration of groundwater. Whereas EPA-sponsored programs are in progress to establish the type and quantity of priority pollutant discharge from various industrial sectors and runoff, the contribution to the total POTW pollutant load from commercial, residential, runoff and groundwater sources is virtually unknown. The literature contains relatively extensive data on concentrations of metals in POTW influents, but little data on concentrations of organics or on the sources of any pollutants. Further complications result from possible concentrations of priority pollutants in public water supplies and the possible generation of these pollutants within the POTW itself.

B. Objectives of Study

In order to assess the sources and extent of priority pollutants entering POTWs, MDSD has planned a two-phased program of sampling and analysis. The first phase - covered by this report - has been conducted at a selected POTW (Cincinnati)*, with the following principal objectives:

- To assess the feasibility of determining the relative contribution of various sources of priority pollutants.
- To test the sampling protocols and operational aspects of sampling and chemical analysis.
- To provide data on priority pollutant loads in a specific POTW.
- To furnish the basis for extending the knowledge gained at the first city to a full-scale sampling and analysis study of five more POTWs in the United States.

In that this was the first in a series of POTWs to be studied, there were actually a number of general questions to be addressed. We have developed and tested methods for establishing sample plans that fulfill the proposed criteria, for collecting samples, and for analyzing the samples within a quality assurance program. Systems for data storage have been installed and guidelines for data workup and interpretation of results have been set up. The data accumulated in this first phase will be used to guide sampling plan development for the entire study in terms of the number of POTWs studied, numbers and locations of samples, logistics, costs, and schedules. In accordance with our objectives, we have gained real information on one POTW System, while learning about the problems and solutions that may be associated with subsequent sites.

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*This particular POTW (Muddy Creek Plant, Metropolitan Sewer District of Greater Cincinnati) was selected by the EPA because (1) it appeared to be a fairly typical secondary treatment plant, serving a predominantly nonindustrial community, (2) some POTW influent pollutant concentrations had been previously measured by the EPA, and (3) the POTW authorities had been highly cooperative with the EPA in other studies.

C. Approach to Muddy Creek Study

In developing the work program for the Muddy Creek Study we have relied on the guidelines provided by MDSD staff. Maintenance of EPA's schedule for the overall program has been given high priority. Proper documentation of sampling and analysis procedures, as well as implementation of an EPA-approved quality assurance program for the laboratory analysis, has also been of prime importance. In the selection of sampling sites within the Muddy Creek area, non-industrial wastewater sources have been given considerable attention, and stormwater runoff sources have had a lower priority. In addition, we have coordinated our efforts with other EPA contractors studying POTW treatment processes.

In order to provide a basis for comparison of the Muddy Creek study with other POTW source studies, a literature search was conducted. The extent of available information was determined with particular attention given to the range of concentrations of priority pollutants in raw wastewater and the contributions of various sources to those pollutant levels.

Based upon the initial literature survey, and information obtained on the Muddy Creek POTW, we have formed a framework of objectives and parameters for the study. The sampling plan was developed with respect to the feasibility of identifying source categories, the accessibility of the locations, and the prospect of obtaining reliable data on the types and levels of toxic pollutants in the sewer district. In addition, we have collected general demographic data on the Muddy Creek area and more specific data on the appropriate sewer subsystems, including density statistics, information on the types of establishments served, precipitation, traffic, etc.

Analytical methods for the various categories of compounds were established as described in the EPA Screening Protocol for Priority Pollutants. Quality control requirements, as outlined in the EPA Verification Phase document, were reviewed and implemented. The sampling phase for the Muddy Creek study was undertaken in two separate trips in order to alleviate analytical laboratory demands.

Samples were analyzed according to the protocol requirements and reported in the formats developed. Data was organized into sets corresponding to each of the toxic pollutants identified, then grouped into cells representing the different sample locations, sample times, etc. We have examined the data for obvious trends and discrepancies, and have applied various statistical tests to explain variations. We have made a qualitative assessment of the apparent relationships between the analytical results and the source characteristics. Finally, results for specific sample locations were compared with those obtained for the POTW influent and the water supply.

III. LITERATURE REVIEW

In order to provide a basis for comparing the Muddy Creek and subsequent POTW source studies, a literature search was conducted. The goals were to determine: (1) the extent of data available on priority pollutants in influents to POTWs; (2) the extent of information on the contribution of various sources to the influent (residential, industrial and runoff); (3) the range of concentration of priority pollutants in raw wastewater; and (4) the fate of the various pollutants across the wastewater treatment plants. The reports developed by and for the EPA which were made available to Arthur D. Little, Inc., by EPA-MDSD were reviewed and the relevant citations within them were obtained, if possible. Some of the results pertinent to planning the Muddy Creek study and probable pollutant concentrations and sources have been summarized in this section and Appendix A. The complete literature review, including all of the references from which the tables in Appendix A were compiled, is published as part 1 of this series of reports on sources of priority pollutants in POTW influents.

Wastewater analyses are generally performed for three purposes: to determine the sources of pollutants, to quantify the water quality or to evaluate the performance of a particular set of treatment processes. Of the investigations reviewed for this study, only about 18% dealt with the sources of toxic materials to wastewater. The remaining papers were evenly split between water quality analysis and process performance evaluations. It is precisely to improve this lack of information on pollutant sources that this source study was undertaken.

The amount of data available for each pollutant is variable. Summary tables of the wastewater concentration data are given in Appendix A.

Silver, beryllium, selenium, and thallium have negligible data bases, while there is substantial information on concentrations of cadmium, chromium, copper, nickel, and zinc in wastewater. There have been moderate amounts of data generated for arsenic, lead, and mercury. Data was available for only 31 of the 114 organic priority pollutants. The organic pollutants with the highest wastewater concentrations were chlordane, dichloromethane, chloroform, 1,2-dichloroethane, 1,1,2,2-tetrachloroethane, ethylbenzene, and toluene.

Existing data for individual wastewater systems are insufficient to predict specific relationships between land use and water pollution. There is, however, a good statistical base from the New York City Metropolitan Area(10) since 99 POTWs were surveyed. With respect to the medial concentration values observed for certain pollutants, there is a definite similarity between the POTW influents in the New York City area and those around the country, implying a "background level" from normal domestic (and commercial) activities. However, when the extreme values are examined, the concentrations in the highly urban and industrial New York Metropolitan area are significantly higher for all the metals observed,with the exception of nickel. These data indicate that the extreme highs are likely to result from the periodic industrial discharges which are more frequent in the New York City area than in many other cities.

Available data has also indicated that site location type (i.e., residential, commercial, or industrial) is a primary factor in pollutant contamination. It is clear that domestic sources can contribute a significant portion of the total metals load in wastewater. In fact, residential contributions of five metals studied (copper, chromium, cadmium, nickel, and zinc) ranged from 25-49% of the total measured metals concentrations. Runoff has been found to generate temporarily high concentrations of some metals, especially mercury.

All of the existing data can be used to suggest possible ranges that might be expected in further studies. However, it is clear that the contamination is significantly different from one region to the next.

The removal efficiencies for primary, secondary, and advanced (pilot plant studies) treatment processes were also reviewed. There is extreme variation; no one process is uniformly successful at removing all metals and no metal is removed in a consistent manner by all processes. Some of the removal data is presented in Appendix A.

The Wastewater Research Division of the Muncipal Environmental Research Laboratory conducted an investigation of the Muddy Creek area in Cincinnati as part of a survey of Municipal Wastewater Treatment Plants for toxic substances.(9) The toxic substances monitored included some of the priority pollutants, and the data relevant to the present study is tabulated in Table III-1. There are differences in the experimental and sampling procedures, but the reported ranges should give an idea of the concentrations to be expected.

TABLE III-1

ANALYSIS OF WASTEWATER FROM MUDDY CREEK TREATMENT PLANT(9)

	Geometric Mean		Measured Range(a)	
	Influent	Effluent	Influent	Effluent
	Metals and Organics (µg/L)			
Arsenic	-	-	<1.5	<1.5
Cadmium	8	3	0.8-150	0.3-130
Mercury	0.5	-	0.5-3.3	0.5-2.0
Cyanide	46	35	10-410	26-132
Chloroform	1.9	0.3(b)	0.7-9	0.1-0.7
Trichloroethylene	0.2	-	0.2-2.3	-
Benzidine	-	-	0.3	<0.1
Vinyl Chloride	-	-	<1.0	<1.0
Benzene	-	-	0.3-2.0	0.3-3.8
PCB's	-	-	<1	-
Endrin	-	-	<1	-
Toxaphene	-	-	<1	-
CCl_4			-	-
Chlorodibromomethane			0.1-0.3	0.1
Dichlorobromomethane			0.1-1	0.1-0.3
Bromoform			0.1-3.6	-
1,2-Dichloroethane			0.4	-
Methylene Chloride			0.2-70	1-10
1,1,1-Trichloroethane			0.3-0.4	-
Tetrachloroethylene			0.2-9	0.3-3
Toluene			1-5	1
Xylene			5-6	10
Acrolein			20-80	10-150
Acetaldehyde			100-2000	100-560
Methanol			-	-
Ethanol			-	-
Acetone			20-400	20-400
2,3-Dithiabutane			10-130	1
Carbon disulfide			2-30	2-8
Total Suspended Solids	101 mg/L	5.3 mg/L	39-228 mg/L	1.7-100 mg/L
Chemical Oxygen Demand	179 mg/L	22 mg/L	44-478 mg/L	13-178 mg/L
Total Organic Carbon	49 mg/L	9.1 mg/L	16-120 mg/L	5-34 mg/L

Notes:

(a) Range of measurable concentrations. Where no measurable concentrations were found, the approximate detection limit is listed.

(b) Value for unchlorinated effluent is given in table. Geometric mean for chlorinated effluent is 3.1 µg/L; measured range is 0.5-12 µg/L.

IV. THE MUDDY CREEK POTW TREATMENT AREA

A. INTRODUCTION

The Muddy Creek POTW treatment area in greater Cincinnati, Ohio, was pre-selected by the Environmental Protection Agency as the candidate site for the pilot source sampling study for several reasons:

(1) Past sampling efforts had been conducted by EPA to measure selected organic and metal pollutants at the POTW;

(2) It was anticipated that the Metropolitan Sewer District of Cincinnati would be cooperative because of past work and their familiarity with the programs of the Environmental Protection Agency;

(3) The general characteristics of the treatment area in terms of its suburban location, sewer systems, mix of residential and commercial areas, etc., were felt to be desirable for the pilot source study; and

(4) The proximity of the EPA Cincinnati laboratories for advice and consultation in sampling and analysis was advantageous.

The initial steps in our program were to conduct two "reconnaissance visits" to the Muddy Creek treatment area, visit with the Metropolitan Sewer District and Muddy Creek POTW personnel, and obtain as much information as possible to determine the suitability of the Muddy Creek treatment area for the initial pilot source study. Arthur D. Little, Inc. staff visited with the director, supervisory, planning and maintenance officials of the Metropolitan Sewer District and the supervisor of the Muddy Creek POTW. These persons were extremely helpful in providing us with information on the POTW, the sewer system, and the Muddy Creek treatment area. They suggested possible locations for sampling, provided detailed sewer maps of the area, and a survey crew to help locate manholes. Discussions were also held with the following persons and agencies in order to obtain additional information on the Muddy Creek treatment area:

Mr. Richard Moran
Planning and Management Support Systems
Planning Commission
City of Cincinnati

Ms. Margo Lindahl
OKI Planning Commission
Cincinnati, Ohio

James Stauffer
Grant, Brundage, Baker & Stauffer, Limited
Cincinnati, Ohio

During these visits we obtained copies of 208 and 201 planning documents, census information, and street maps. We found all of these sources of data very useful in selecting sampling locations, in developing information which characterizes the Muddy Creek treatment area, and in assuring ourselves (and the EPA) of the suitability of the Muddy Creek area for the pilot program. Following these initial visits, our staff made a comprehensive tour of the Muddy Creek POTW and treatment area in order to locate potential sampling sites and obtain general information useful in characterizing the area.

Earlier in this report we described the goals of the POTW source program. One specific goal was the determination of the relative contribution of commercial, residential, and industrial sources to the pollutant load at POTW's. Ultimately, it would be desirable to relate these contributions to the characteristics of the area, i.e., the population density, type and age of housing, type and size of commercial and industrial establishments, traffic patterns, etc. We recognized that in the pilot program these relationships could not be established in any detail. However, we felt that it was essential to characterize the Muddy Creek treatment area so that ultimately one might be able to relate the loading of priority pollutants to economic, demographic, and other factors characterizing treatment areas.

The approach that we followed was to characterize the total treatment area in general and in the individual "sampling sites" (i.e., the smaller zones within the treatment area from which we collected samples of raw sewage) in more detail. The parameters that were of interest included:

area, population, land use, number, age and type of residences, types and numbers of commercial and industrial establishments, numbers and types of institutional facilities (hospitals, schools, etc.), topography, rainfall, and general traffic. We planned to use published information wherever possible, e.g., census data, etc., and to collect limited data in the individual sampling areas. Collection of these data would serve several purposes. First, it would assist in selecting sampling sites. Second, we consider the collection of economic and demographic information to be another part of the "pilot program." Thus several different techniques to ascertain the required demographic information were assessed, including: use of published federal records such as census information, use of information available at the county and/or city level, and direct collection of specific data in parts of the treatment area. Our goal was to determine how useful various sources of information would be and to develop a general method for collection of demographic data which could be used at other sites in subsequent sampling programs.

We found that no one source of data was sufficient to characterize the areas. This occurred for several reasons. First, the boundaries of the Muddy Creek POTW are not the same as other boundaries in the county and the city area. For example, less than one-fourth of the Muddy Creek treatment area is within the corporate limits of Cincinnati. Although there are excellent demographic data maintained by the city, it is applicable only to a small portion of the treatment area. Second, the county maintains different types of information than the city, so that complete information was not available for the entire treatment area. Third, the treatment area contains four or more towns and townships. The individual governments of these zones maintain different types of data. Fourth, we could not locate any consolidated set of data on industrial or commercial facilities in the area. Finally, although the Metropolitan Sewer District had excellent maps and diagrams of the sewer system, and were extremely cooperative in helping us locate manholes, sample sites and general areas, it was not possible to use their records to determine the numbers of persons connected to the sewers in different areas or subsystems. Further, the principal commercial users of the sewer system could not be readily identified from the records.

As a result of the availability and variability of certain information and the lack of other information, we obtained general information on the total Muddy Creek treatment area from published documents, namely 201 and 208 plans, and census data. We made direct determinations of the number and types of houses, commercial and industrial facilities in each sampling area by using a field reconnaissance team. (We have not disclosed the names of individual facilities, stores, etc.) These data were compared to available data in the 201 plan and/or census data. We were unable to obtain data on water use by residential and commercial sources nor were we able to determine in detail the employment in the commercial or industrial locations in the area. Nevertheless, we believe that the characterization of the Muddy Creek treatment area will be useful in examining the results of the study and give an indication of what can be expected to be obtained at other sampling areas.

In the following sections, we first describe the Muddy Creek POTW, the Muddy Creek treatment area and then each sampling area. The details of the sampling plan are presented in Section V.

B. THE MUDDY CREEK POTW

The Muddy Creek Wastewater Treatment Plant was originally completed in 1961 and later expanded in 1973. The secondary treatment plant is designed for 15 million gallons per day and to produce an effluent containing not more than 10 mg/L of biochemical oxygen demand and 12 mg/L of suspended solids. The plant is located on River Road and receives influent from the River Road Interceptors. The activated sludge plant normally operates at about 8-10 mgd. A complete description of the facility is given in "Facilities Plan: Vol. 3, Report for the Muddy Creek Wastewater Treatment Plant and Sanitary Interceptor Sewer System," prepared by Grant, Brundage, Baker & Stauffer, Limited, Cincinnati, Ohio, 1977 (part of the 201 Plan).

The samples we obtained at the Muddy Creek Wastewater Treatment Plant influent stream (code POTW-INF) were obtained just after the initial centrifugal pumps and rising well, in the inlet to the detritus tanks (grit tanks). The samples obtained by Burns and Roe Engineering Services used in another related program were obtained from the same location.

C. GENERAL DESCRIPTION OF MUDDY CREEK POTW TREATMENT AREA

The Muddy Creek treatment area is located in the western part of the greater Cincinnati Metropolitan area. It is bounded by the Ohio River on the south, the Mill Creek treatment area on the east, a mostly undeveloped area on the west, and the Taylor Creek drainage area on the north. The area can best be described as "suburban Cincinnati." The Muddy Creek treatment area is approximately 18,850 acres (29.4 sq miles) and has an estimated 1976 population of 87,879.* It contains a combination of open areas, new housing developments, older residential communities, several golf courses and other recreation areas, schools and seminaries, shopping centers, commercial areas, and a small amount of industrial activity. Figure IV-1 gives an overview of the Muddy Creek area indicating some of these major features.

The 208 plan lists the following zoning classifications for the area:

Residential	96.6%
Retail Business & Offices	1.0%
Light Industrial	1.7%
Heavy Industrial	0.7%

The land use classifications given in the 208 plan are:

Residential	57.4%
Institutional	3.2%
Retail Business & Offices	2.5%
Light Industrial	3.0%
Recreational	3.1%
Undeveloped	23.6%
Proposed Development	7.2%

---

*These data are from Facilities Plan, Vol. 1, prepared by Grant, Brundage, Baker & Stauffer, Ltd, for the Metropolitan Sewer District of Greater Cincinnati, June 1976 - "the 201 Plan." There is a discrepancy in size of the "planning area" for Muddy Creek given in this report and the size given in the Muddy Creek Treatment Plant brochure of 22.5 sq miles.

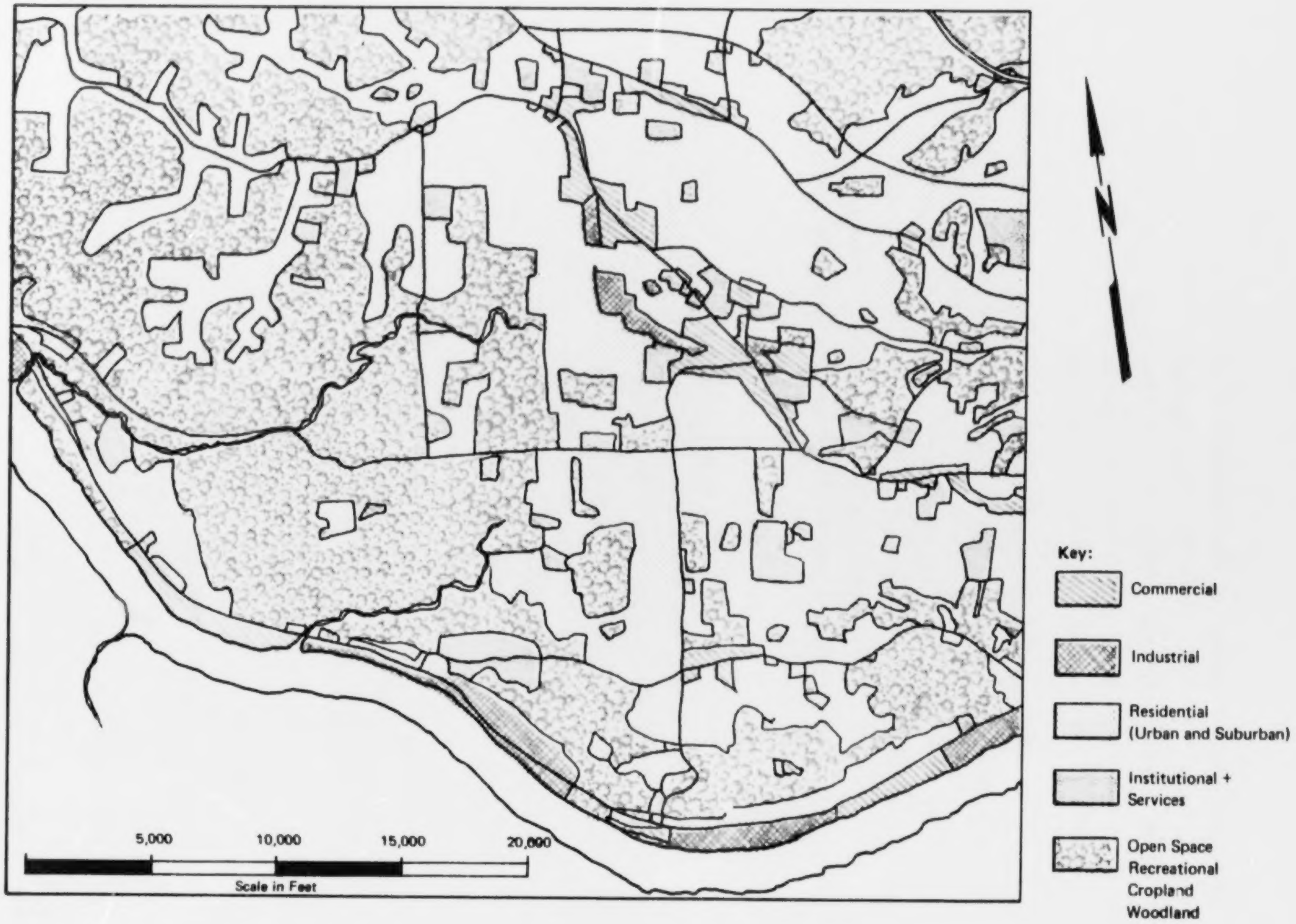

N
Key:
Commercial
Industrial
Residential (Urban and Suburban)
Institutional + Services
Open Space Recreational Cropland Woodland
5,000
10,000
15,000
20,000
Scale in Feet

FIGURE IV–1 OVERALL LAND USE MAP

1. Communities and Residential Areas

The Muddy Creek treatment area contains parts of the incorporated municipal areas of Cincinnati and Cheviot and all of the incorporated municipal area of Addyston. It includes parts of Green Township and Miami Township and all of Delhi Township. The portion within the corporate limits of Cincinnati, Cheviot and Addyston are older, built-up areas and were probably developed before 1940. Major new construction in these areas has been schools, shopping centers, and apartment buildings. The Township areas are more open, but are the sites of recent housing construction. Delhi Township has a combination of new and old housing and a small shopping area. Most of the recreational areas are central to the Muddy Creek area. The major new residential areas are in the west and northwest, with new construction continuing to meet the expanding needs of Cincinnati. The newer western area has only residences and no commercial or industrial establishments. Some open areas remain in the central, west and river areas because the land is privately held and not available to developers, is part of recreational areas, or is too hilly for easy development. There is a small amount of agricultural land--small farms--in the area.

2. Commercial Areas

The commercial areas in Muddy Creek include portions of the communities of Cheviot, Addyston and Sayler Park (part of incorporated Cincinnati), "strip commercial" areas along River Road (U.S. Route 50) and Glenway Avenue (State Route 264), and the Western Hills, Western Woods, and Delhi Plaza shopping centers. In the older communities, the main streets have a combination of commercial and residential buildings, ranging from "corner stores" to supermarkets to restaurants/taverns to small office professional buildings, spread throughout the area. The "shopping centers" are also clustered just south of Cheviot and in Delhi Township.

3. Industrial Areas

Most of the industry in Muddy Creek is "light industry." The main industrial area is located along River Road, and consists primarily of grain elevators, oil and fuel terminals, machine tool and metal working companies, and one major chemical facility which has a separate NPDES permit. The smaller industrial zones are along the major railway lines and the highways in the eastern portion of Muddy Creek. There are metal working facilities, box and insulation companies, and similar light manufacturing organizations.

4. Drainage Areas and Sewers

There are four drainage areas within the Muddy Creek Drainage Basin. They are characterized below:

Drainage Area	Length of Sanitary Sewers	Sewer System Type	Diameter of Sanitary Sewers
River Road	4.72 miles	combined	8" to 12"
West Muddy Creek	6.58 miles	sanitary	8" to 15"
East Muddy Creek	37.05 miles	combined	8" to 15"
Rapid Run	24.13 miles	combined	8" to 15"

Source: Inflow and Infiltration Study - 201 Plan (see below)

In addition, there are 60.64 miles of combined sewer. There are 21 pumping stations in the area and numerous overflow points from pumping stations and combined sewer connections.

The sewers are mostly concrete in construction and range in age from recent to over 50 years old, with an average of 20 years. The combined sewers are usually concrete and can range up to 15' x 10' in size. The "Inflow/Infiltration Analysis" portion of the 201 planning report prepared by Grant, Brundage, Baker & Stauffer for the Metropolitan Sewer District of Greater Cincinnati gives a complete description of the system sizes, flows, etc. Infiltration in the subsystems and interceptors was estimated in the 201 study to amount to as much as 40-50% of the total flow to the POTW.

5. Other Data

Other data that may be of use in characterizing the area are topography, geology/soils, precipitation, population, etc. Some of the highlights of these data, obtained from the 201 planning study are given in Table IV-1.

TABLE IV-1

SELECTED DATA ON THE MUDDY CREEK AREA*

Topography

Elevation: 455-922 feet above mean sea level

Terrain: gently rolling, falling off steeply to river

Streams: many small, major streams are Muddy Creek & Rapid Run

Climate

Normals for 1941-1970

Daily Maximum: 64.4°F

Daily Minimum: 43.5°F

Degree days (65°F base): 5070 heating; 1080 cooling

Precipitation: 39.04 inches

Extremes in Same Period

Temperature - High 102°F, Aug. 1962
Low -19°F, Jan. 1963

Precipitation (monthly) Max. 12.18, March 1964
Min. 0.18, Sept. 1963

Soils

Medium to strongly acid

Moderate in fertility and productivity

Silt loam, silty clay loam

Population Growth--Muddy Creek

1970	85,525
1976	87,879
1980 (est)	89,109
2000 (est)	102,561

---

* Data from 201 Study (see earlier reference).

D. DESCRIPTION OF SAMPLING SITES WITHIN THE MUDDY CREEK TREATMENT AREA

1. Sampling Site Locations

Figure IV-2 shows the locations of the 6 sampling sites for this program in relation to the total Muddy Creek treatment area. The collection areas for the sewers which were sampled are also indicated. Table IV-2 presents pertinent information for each sampling location, including the "code name" for the site and the type and location of sewer from which the samples were obtained. Except as noted in the table, flow measurements were made in the same locations used for obtaining the samples. Most of the sampling locations are on the boundary of the zones sampled. The Kirkridge sampling location was about 0.4 mile from the zone in order to assure accessibility to the manhole for sampling.

2. Delfair Sampling Area

The Delfair sampling area is located in Delhi Township in the southeastern portion of the Muddy Creek treatment area. Figure IV-3 shows the sampling location, general land use patterns, and streets in the area. The Delfair area includes Subsystem 1B and a portion of Subsystem 1C of the Muddy Creek treatment area.

The Delfair area is characterized as a residential/commercial site. The commercial area consists of several relatively small shopping plazas, located on both sides of Delhi Pike, and a number of isolated stores, banks, professional offices, and small businesses (some in converted residences) located primarily on Delhi Pike and Mt. Alverno Road. The residential area consists predominantly of single family houses (about 10 to 20 two-family homes), brick or wood frame construction in two distinct groups: those built prior to 1940 and those built after 1950, including a new subdivision currently under development. There is little open space in the area, except in the yet undeveloped portion in the south. Individual lot sizes range from about 5000 to 10,000 sq feet, except in the more newly developed areas where larger lots are common. Data characterizing the Delfair sampling area are summarized in Table IV-3.

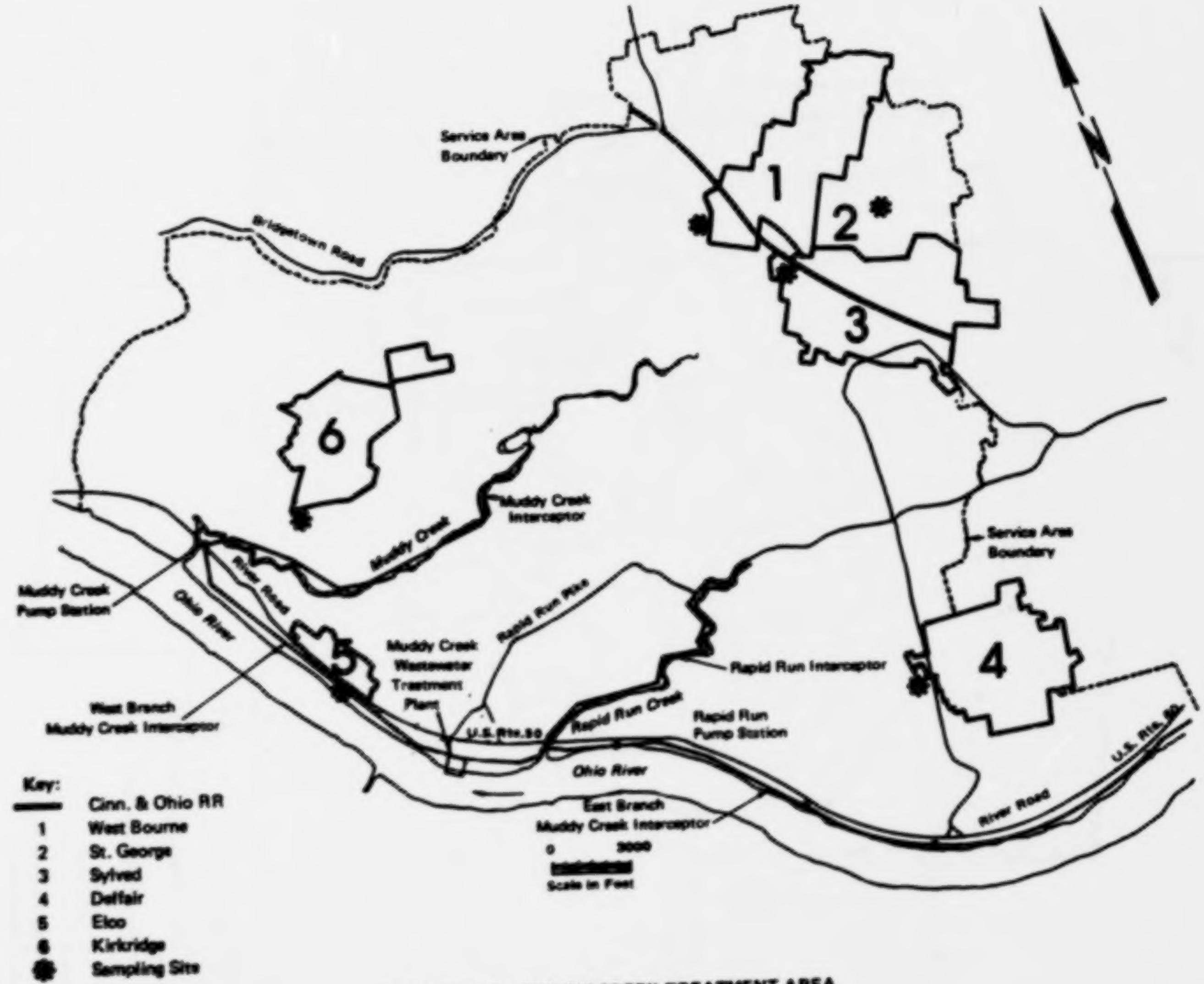

N
Service Area Boundary
Bridgetown Road
1
2
3
4
5
6
Muddy Creek Interceptor
Muddy Creek
Service Area Boundary
Muddy Creek Pump Station
River Road
Ohio River
Rapid Run Pike
Muddy Creek Wastewater Treatment Plant
Rapid Run Interceptor
West Branch Muddy Creek Interceptor
U.S. Rte. 50
Rapid Run Creek
Rapid Run Pump Station
Ohio River
East Branch Muddy Creek Interceptor
River Road
U.S. Rte. 50
0 3000
Scale in Feet
Key:
Cinn. & Ohio RR
1 West Bourne
2 St. George
3 Sylved
4 Delfair
5 Elco
6 Kirkridge
Sampling Site

FIGURE IV–2 MUDDY CREEK TREATMENT AREA

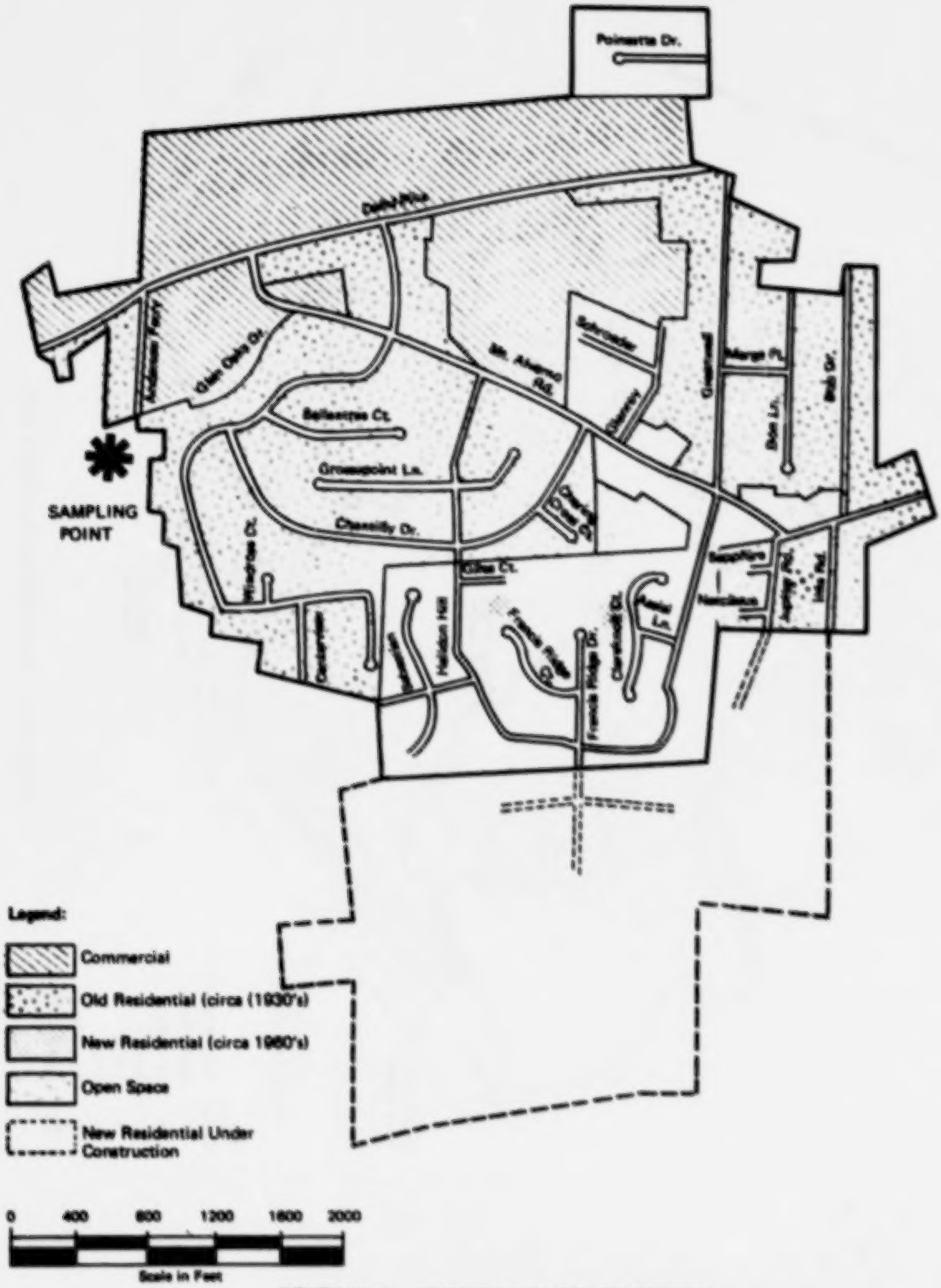

Poinsettia Dr.
Delhi Pike
Anderson Ferry
Glen Oaks Dr.
Mt. Alverno Rd.
Schroeder
Greenwell
Margo Pl.
Don Ln.
Bob Dr.
Bellecrest Ct.
Grosspoint Ln.
Chantilly Dr.
SAMPLING POINT
Gibe Ct.
Halidon Hill
Francis Ridge Dr.
Clearbrook Ct.
Sapphire
Narcissus
Ashley Rd.
Iris Rd.
Legend:
Commercial
Old Residential (circa 1930's)
New Residential (circa 1960's)
Open Space
New Residential Under Construction
0
400
800
1200
1600
2000
Scale in Feet

FIGURE IV–3 DELFAIR LAND USE AND STREETS

TABLE IV-2

DESCRIPTION OF SAMPLING SITES IN MUDDY CREEK

"Code Name"	Description of Area (area type/sewer type)	Sampling Location	Sewer Characteristics
Delfair	Residential-commercial/sanitary	on west side of Anderson Ferry Rd, 800 ft south of Delhi Turnpike	15" diameter, depth 7 feet, slope 1.32%
Elco	Old residential/combined	at extension of Elco Street, where sewer joins River Road interceptor	32" diameter, depth 11 feet, slope 2.5%
Kirkridge	New residential/sanitary	on north side of Hillside Ave., at intersection of Lowland Road	12" diameter, depth 15 feet, slope 6.8%
West Bourne	Residential-commercial-industrial/combined	Approximately 100 ft SE of rear of Glidden Paint store, off West Bourne Rd.	15" diameter, depth 9 feet, slope 0.42%
Sylved	Residential-industrial/combined	Approximately 75 ft behind Mack Fire House on Sylvan Lane	96" diameter, depth 10 feet, slope 0.82%
St. George	Institutional/sanitary	Approximately 200 ft to the rear of St. George Hospital	24" diameter, depth 29 feet, slope 4%
POTW Influent	Influent to POTW	Sample taken at inlet to grit chamber	

TABLE IV-3

CHARACTERISTICS OF DELFAIR SAMPLING AREA

Location:	Southeast portion of Muddy Creek area
Main Streets:	Delhi Pike, Mt. Alverno Road, Anderson Ferry Rd
Category:	Commercial-residential/sanitary sewer
Size:	Approximately 0.56 sq miles
Population:(a)	2,856 (census); 2,832 (ADL estimate); 2,505 (I/I Analysis Report)
Residences:	Approximately 700 single family housing including 90 in newly developed area(b) Less than 5 multiple family structures Lot size typically 5000 to 10,000 sq ft(c) Housing age varies from about 50 years to newly constructed; between 50-60% is estimated to be older housing(d)
Major Commercial Establishments(e)(f)	
Automobile related:	2 gasoline service stations (554)
Professional Bldgs	7 buildings, for between 2-6 professionals each
Services:	3 banks; 1 building supply (521); 1 barber (7241)/ 1 hairdresser (7231)
Retail Stores:	19 retail specialty (59); 8 food stores (5410); 1 pet shop (59)
Eating Places:	2 fastfood (58); 1 restaurant/lounge (58)
Other:	1 greenhouse/garden supply (526); 1 daycare center (835); office space in plaza of about 3000 sq ft.
Institutional Facilities:	Church
Industrial Facilities:	None

Notes: (a) Population estimates as follows: census--estimated from 1970 census data (estimates required because census blocks do not necessarily coincide with sewer system boundaries); ADL estimate--from staff observations of number of single and multiple housing units and estimated 4 persons/housing unit. I/I Analysis Report--population reported for appropriate subsystem of Muddy Creek from 201 Plan Report.

TABLE IV-3 (Continued)

(b) Estimated from lot counts using sewer maps and from visual observations of ADL staff.

(c) Estimated from sewer system map and visual observations of ADL staff.

(d) Estimated by ADL staff.

(e) Estimated numbers and types of establishments observed by ADL staff on tour of the area. The numbers are not intended to be precise, but to give a relative indication of the type of commercial or industrial activity.

(f) SIC codes are given in parentheses.

3. Elco Sampling Area

The Elco sampling area is located in the southwest part of the Muddy Creek treatment area in the community of Sayler Park. Figure IV-4 shows the sampling area, main streets and sampling location. The main streets in the area include River Road and Gracely, Monitor, and Parkland Streets. The Elco area is part of Subsystem 66 of the Muddy Creek treatment area.

The Elco area is characterized as an old residential/combined sewer area. The area is almost entirely residential with a few "neighborhood" stores. Sayler Park is an old community; many of the houses date to the turn of the century. There are several new apartment buildings of relatively small size built within the last 10 years. The Sayler Park area is separated from the Ohio River by U.S. Route 50 (River Road), a rail line, and an open area bordering on the river. In the Elco sampling area, there are no structures or commercial/industrial use of the land between River Road and the Ohio River. There is a small amount of open space--town common--in the sampling area. Data characterizing the Elco area are summarized in Table IV-4.

During the first sampling period, August 8, 9 and 10, maintenance work was in progress on River Road, U.S. Route 50, in the Elco area. The work consisted of trimming and cutting the concrete roadway and hosing down the debris. Since the sewers are combined sanitary/storm sewers, some of the road materials were flushed into the sewer during the sampling period.

4. Kirkridge Sampling Area

The Kirkridge sampling area is centrally located in the western part of the Muddy Creek treatment area. Figure IV-5 shows the sampling location, the general land use, and streets in the area. Kirkridge is part of Subsystem 20 of the Muddy Creek treatment area.

The Kirkridge sampling area is characterized as a new residential/sanitary sewer area. There are no commercial, industrial or institutional

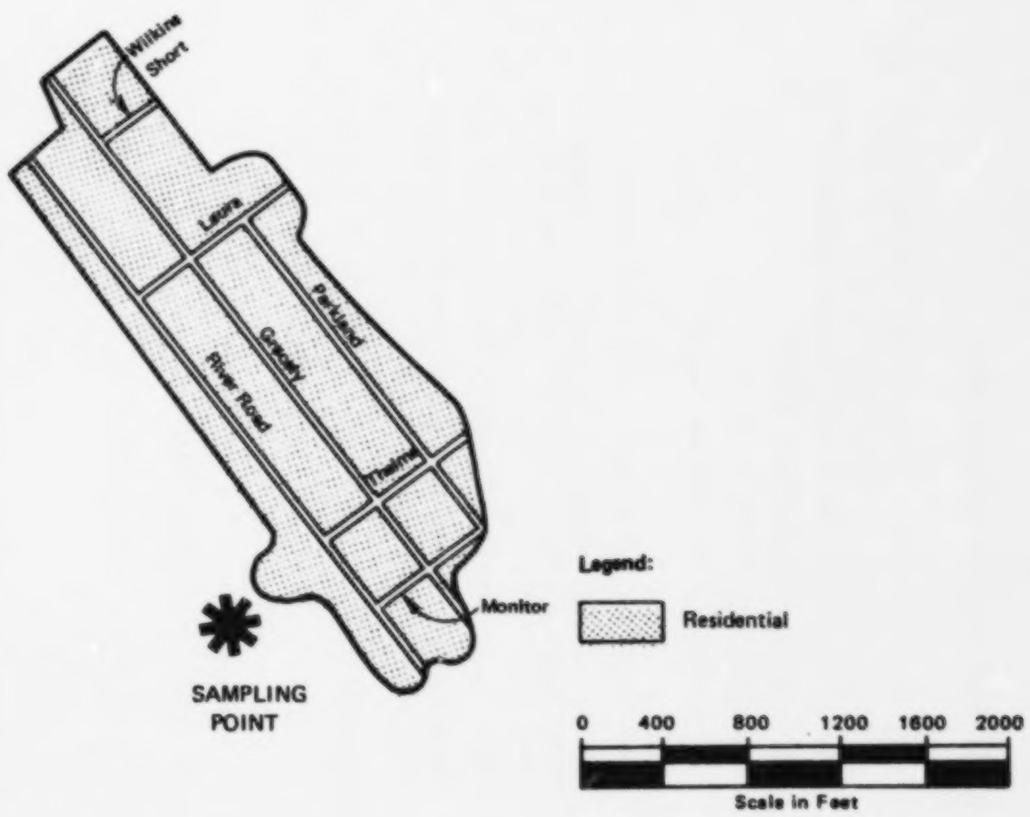

Wilkins
Short
Laura
Parkland
Gracely
River Road
Thelma
Monitor
SAMPLING POINT
Legend:
Residential
0
400
800
1200
1600
2000
Scale in Feet

FIGURE IV–4 ELCO LAND USE AND STREETS

TABLE IV-4

CHARACTERISTICS OF ELCO SAMPLING AREA

Location:	Southwest portion of Muddy Creek treatment area in the community of Sayler Park
Main Streets:	River Road (U.S. Route 50), Gracely Drive
Category:	Old residential/combined sewers
Size:	Approximately 0.085 sq miles
Population:(a)	472 (census), 728 (ADL estimate)
Residences:	Approximately 120 single-family residences; 10 two-family residences; 8 multiple residence apartments estimated as six 4-unit, one 6-unit, one 12-unit(b) Lot size typically 8000 to 25,000 sq ft(c) Housing age is variable from about 80 years to newly constructed apartment buildings(d)
Major Commercial Establishments(e)(f)	
Automobile Related:	1 gasoline service station (554)
Retail stores:	2 specialty (59); 2 food (5410)
Eating places:	1 restaurant/lounge (58)
Institutional facilities:	1 church, 1 post office
Industrial Facilities:	none

Notes: (a) Population estimates as follows: census--estimated from 1970 census data (estimates required because census blocks do not necessarily coincide with sewer system boundaries); ADL estimate--from staff observations of number of single and multiple housing units and estimated 4 persons/housing unit.

(b) Estimated from lot counts using sewer maps and from visual observations of ADL staff.

(c) Estimated from sewer system map and visual observations of ADL staff.

(d) Estimated by ADL staff.

(e) Estimated numbers and types of establishments observed by ADL staff on tour of the area. The numbers are not intended to be precise, but to give a relative indication of the type of commercial or industrial activity.

(f) SIC codes are given in parentheses.

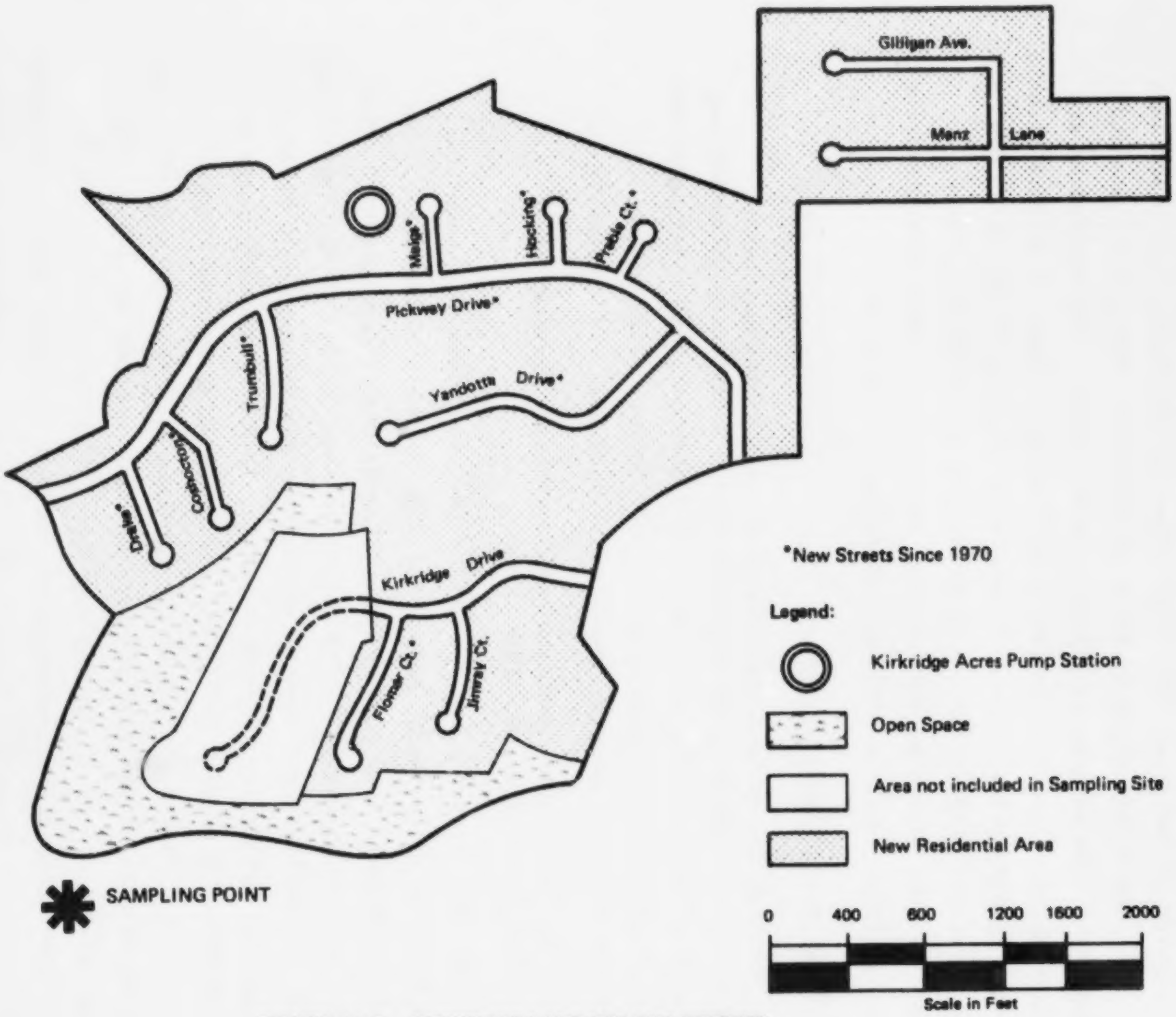

Gilligan Ave.
Menz
Lane
Meigs*
Hocking*
Preble Ct. *
Pickway Drive*
Yandotta Drive*
Trumbull*
Coshocton*
Drake*
Kirkridge Drive
Flomar Ct. *
Jimray Ct.
SAMPLING POINT
*New Streets Since 1970
Legend:
Kirkridge Acres Pump Station
Open Space
Area not included in Sampling Site
New Residential Area
0
400
800
1200
1600
2000
Scale in Feet

FIGURE IV–5 KIRKRIDGE LAND USE AND STREETS

facilities in the area. The subdivision was developed within the last 15 years and construction is still in progress. Several streets and many homes have been built since the last census. The residences are all relatively large (estimated to be 8 or more rooms, 2 or more baths), single family, brick or wood structures on lots of 20,000 to 40,000 sq ft. The principal streets include Kirkridge Drive and Pickway Drive. There is some open area which is yet undeveloped. Data characterizing the Kirkridge sampling area are summarized in Table IV-5.

5. West Bourne Sampling Area

The West Bourne sampling area is located in the northeast portion of the Muddy Creek treatment area. A portion of the sampling area is within the corporate limits of Cincinnati, and a large portion is within the incorporated community of Cheviot. Figure IV-6 shows the sampling location, the general land use, and streets in the area. The West Bourne sampling area comprises Subsystem 41 of the Muddy Creek treatment area.

The West Bourne area is characterized as residential-commercial-industrial/combined sewer area. The area in the southwestern portion, between Werk Road and Glenway Ave. (and along part of Glenway Ave.) is light industrial. The major shopping centers in the Muddy Creek area--Western Village, Western Woods Plaza and Western Hills Plaza--are located on both sides of Glenway Avenue. The area directly north of these shopping centers on Glenway Avenue contains several apartment houses. The middle portion of the sampling area contains primarily one- and two-family houses most of which are more than 40 years old. The older houses are mostly wooden construction; houses built in the 1920-1940's are often brick construction, and new apartments are mostly brick construction. There are "strip commercial" areas along Harrison Avenue and Glenmore Avenue consisting of older specialty stores, service stations, banks, office buildings, etc. These areas are part of the older community of Cheviot. There is little open area, except for several schools and playground areas. The residential and commercial lot sizes, except in the shopping centers in the south, are small, ranging from about 5000 to 15,000

TABLE IV-5

CHARACTERISTICS OF KIRKRIDGE SAMPLING AREA

Location: West central portion of Muddy Creek treatment area

Main Streets: Kirkridge Drive, Pickway Drive

Category: new residential/sanitary sewer

Size: Approximately 0.45 sq miles

Population:(a) 1,058 (census); 1,012 (ADL estimate)
1,098 (I/I Analysis Report)

Residences: Approximately 253 single-family residences(b)

Lot size typically 20,000 to 40,000 sq ft(c)

All new housing (less than 15 years); some housing under construction(d)

Major Commercial Establishments:

None

Institutional Facilities:

None

Industrial Facilities:

None

Notes: (a) Population estimates as follows: census--estimated from 1970 census data (estimates required because census blocks do not necessarily coincide with sewer system boundaries); ADL estimate--from staff observations of number of single and multiple housing units and estimated 4 persons/housing unit. I/I Analysis Report--population reported for appropriate subsystem of Muddy Creek from 201 Plan Report.

(b) Estimated from lot counts using sewer maps and from visual observations of ADL staff.

(c) Estimated from sewer system map and visual observations of ADL staff.

(d) Estimated by ADL staff.

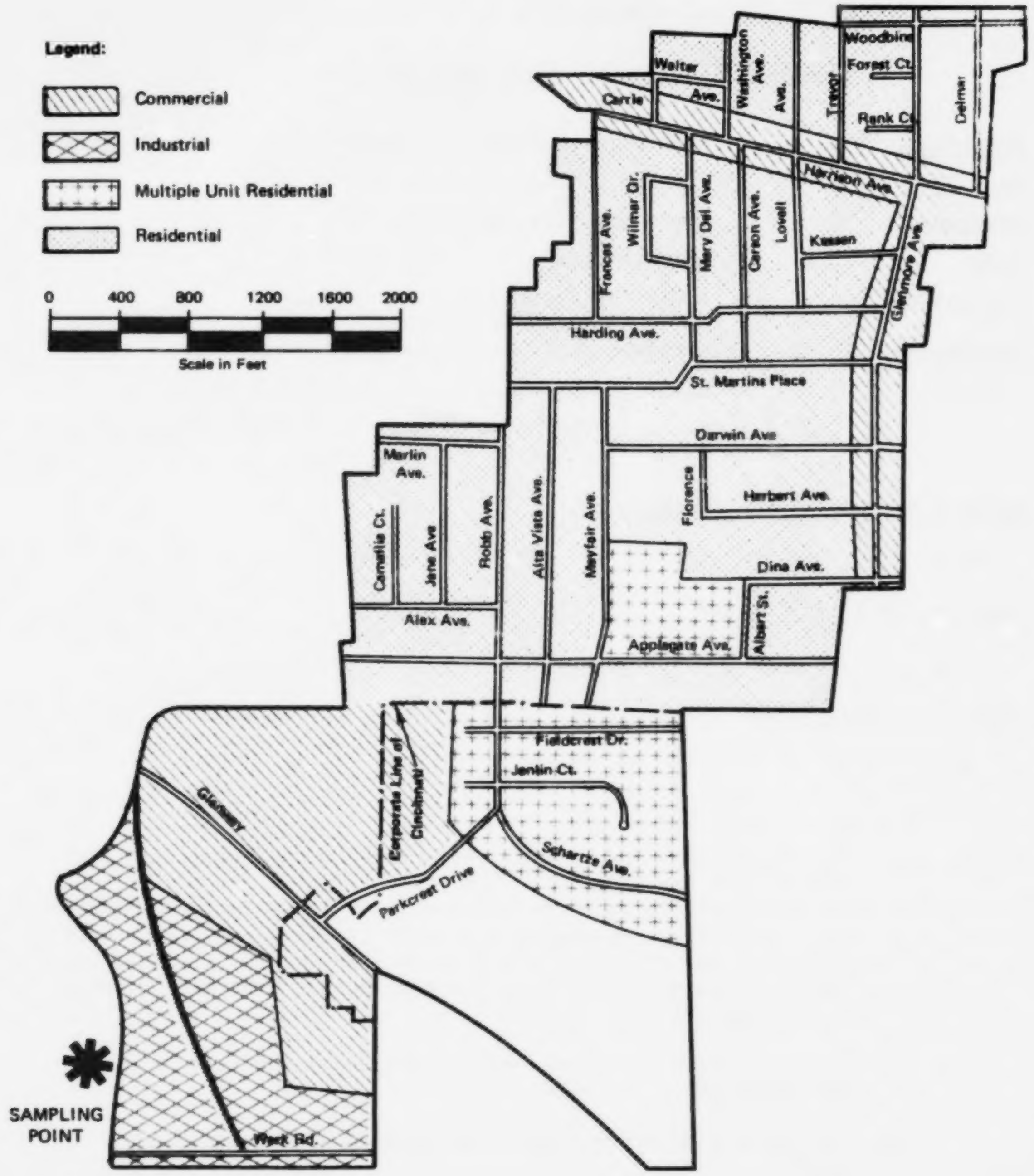

Legend:
Commercial
Industrial
Multiple Unit Residential
Residential
0
400
800
1200
1600
2000
Scale in Feet
Walter
Washington Ave.
Woodbine
Forest Ct.
Carrie
Ave.
Ave.
Trevor
Rank Ct.
Delmar
Harrison Ave.
Frances Ave.
Wilmar Dr.
Mary Del Ave.
Carson Ave.
Lovell
Kessen
Glenmore Ave.
Harding Ave.
St. Martins Place
Darwin Ave.
Marlin Ave.
Florence
Herbert Ave.
Camellia Ct.
Jane Ave.
Robb Ave.
Alta Vista Ave.
Mayfair Ave.
Dina Ave.
Albert St.
Alex Ave.
Applegate Ave.
Fieldcrest Dr.
Jenlin Ct.
Glenway
Corporate Line of Cincinnati
Schartze Ave.
Parkcrest Drive
SAMPLING POINT
West Rd.

FIGURE IV–6 WEST BOURNE LAND USE AND STREETS

sq ft. The principal streets are those on or near the boundaries--Glenway Avenue, Glendale Avenue, and Harrison Avenue. Data characterizing the West Bourne sample area are summarized in Table IV-6.

6. Sylved Sampling Area

The Sylved sampling area is located in the eastern central portion of the Muddy Creek treatment area. Figure IV-7 shows the general land use, sampling location and the principal streets. The Sylved sampling area includes Subsystems 61 and 57 of the Muddy Creek treatment area.

The Sylved sampling area is characterized as a residential-industrial/combined sewer site. A major feature of the area is a railway line dividing the area almost in half with an open area surrounding it. The principal industrial areas are along Crookshank Avenue and Anderson Ferry Road. There are some commercial buildings mixed in with the industrial area. There are also commercial establishments on Glenway Avenue and Ferguson Road. The residential areas are south of the industrial zone (mostly older housing), in the north and east between Glenway Avenue and Ferguson (mostly older housing) and at the western edge of the area near the sampling point (mostly new). Thus the housing is mixed new and old with primarily single family units, some duplexes, and several newer 4 to 6 unit apartment buildings. There is also a trailer park near the center of the area which contains about 50 single-family trailers (relatively small). House lot sizes are generally small. Data characterizing the area are summarized in Table IV-7.

7. St. George Hospital

St. George Hospital is a community hospital located in the east central part of the Muddy Creek treatment area between the Sylved and West Bourne areas. It consists of one principal building with parking lot surrounding it. The sampling point we selected permitted collection from the main building of the hospital but not from the surrounding area. The hospital has 82 beds, emergency room, outpatient area, and other facilities common to community hospitals. It was built in 1968.

TABLE IV-6

CHARACTERISTICS OF THE WEST BOURNE SAMPLING AREA

Location:	Northeastern portion of Muddy Creek treatment area
Main Streets:	Glenway Ave., Glendale Ave., Harrison Ave.
Category:	Residential-commercial-industrial/combined sewers
Size:	Approximately 0.61 sq miles
Population:(a)	2,991 (census), 3,350 (ADL estimate); 3,263 (I/I Analysis Report)
Residences:	Approximately 700 single residences; approximately 135 two-family houses; about 45 structures having between 3 and 10 units; a complex of 12 buildings each with 11 units; and 4 buildings with approximately 20 units.(b) Lot size typically 5000-15,000 sq ft(c) Age of housing varies from over 80 years to newly constructed apartments. Almost all single and two family homes are more than 40 years old.(d)

Major Commercial Establishments (excluding shopping centers)(e)(f)

Automobile related:	3 service stations (554), 4 automobile dealers (551), 4 auto parts/repair (753), 1 car wash (553)
Professional Buildings:	8 physician and dentist offices (801/802); 5 legal (81) or insurance (63) offices; 9 realtors (65); 1 animal hospital (074); 1 small dental laboratory (802); 1 mortuary
Services:	3 electrical supply stores (506); 9 barber (7241)/ hairdressers (7231); 6 banks (60); 2 photographers (722); 6 miscellaneous establishments
Retail stores:	5 fastfood (58), 13 restaurant/lounge (58)
Office Bldgs:	2 with 10-20 offices
Institutional:	churches 3; police and fire stations; 1 municipal building; 2 public schools; 4 small private schools; 1 cementary
Undeveloped:	playgrounds, several parking areas

Shopping Centers(e)(f)

One small center:	11 tenants--2 banks (60); 3 specialty stores (59); 1 drycleaner (7212); 1 laundromat (7215); 1 fastfood (58); 1 grocery (541); 2 hairdressers (7231)

TABLE IV-6 (Continued)

One medium center:	21 tenants--6 clothing (56); 2 department (531); 4 specialty (59); 2 fastfood (58); 1 restaurant (58); 1 bank (60); 1 cinema; 4 miscellaneous stores
One medium/large center:	39 tenants--11 retail specialty (59); 6 clothing (56); 3 department (531); 2 restaurants (58); 1 grocery (54); 1 hardware (525); 3 banks (60); 12 miscellaneous small retail and/or office (59)

Industrial Establishments: [(e)(f)]

Metal products and fabrication companies: 4 - total employment 170 (344)

Vending company (39)

Paper box company: 1 - employment 15 (26)

Notes: (a) Population estimates as follows: census--estimated from 1970 census data (estimates required because census blocks do not necessarily coincide with sewer system boundaries); ADL estimate--from staff observations of number of single and multiple housing units and estimated 4 persons/housing unit. I/I Analysis Report--population reported for appropriate subsystem of Muddy Creek from 201 Plan Report.

(b) Estimated from lot counts using sewer maps and from visual observations of ADL staff.

(c) Estimated from sewer system map and visual observations of ADL staff.

(d) Estimated by ADL staff.

(e) Estimated numbers and types of establishments observed by ADL staff on tour of the area. The numbers are not intended to be precise, but to give a relative indication of the type of commercial or industrial activity.

(f) SIC codes given in parentheses.

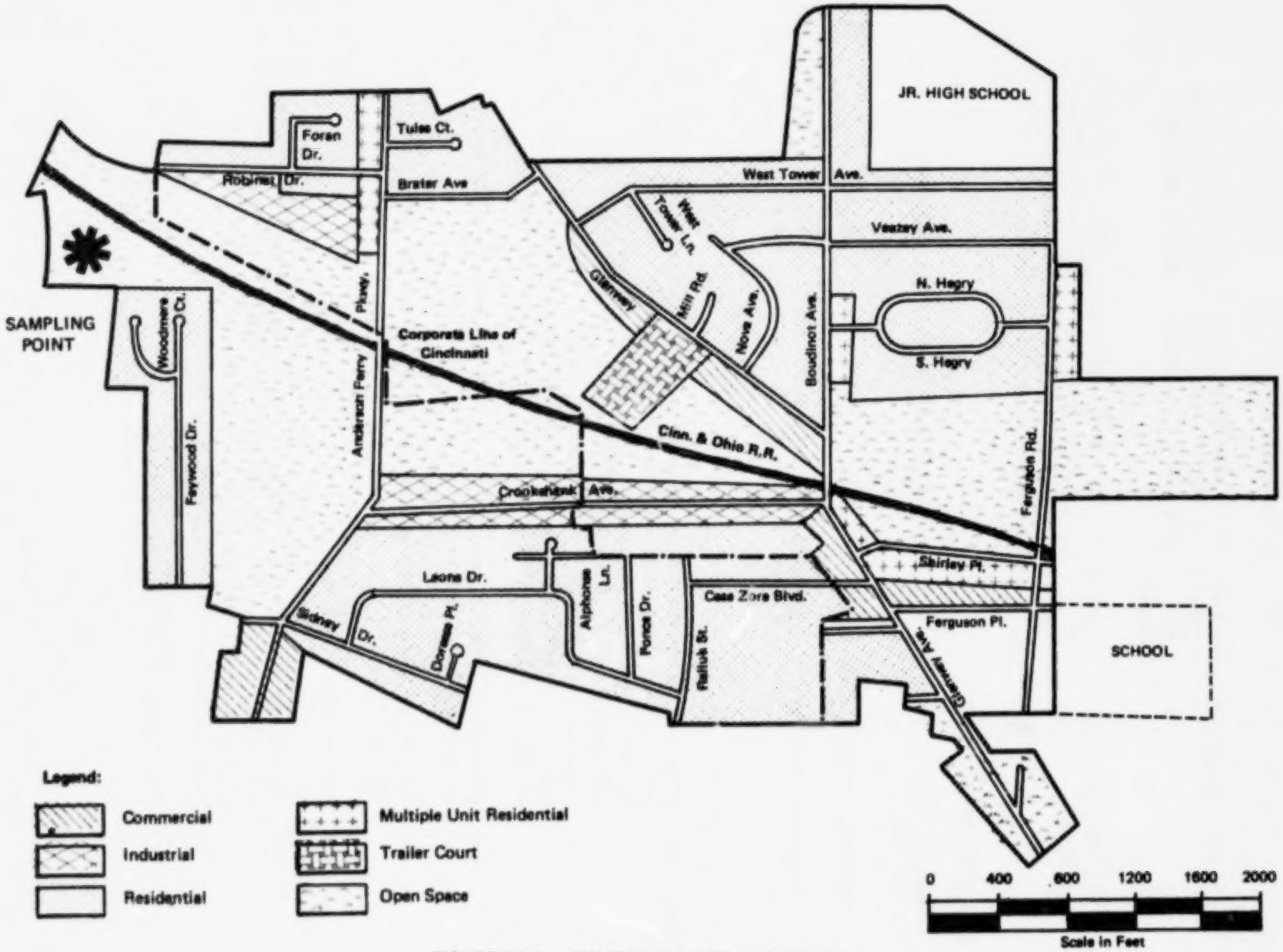

SAMPLING POINT
JR. HIGH SCHOOL
SCHOOL
West Tower Ave.
West Tower Ln.
Veazey Ave.
N. Hagry
S. Hagry
Foran Dr.
Tules Ct.
Robinet Dr.
Brater Ave
Glenway
Mill Rd.
Nova Ave.
Boudinot Ave.
Woodmere Ct.
Feywood Dr.
Anderson Ferry Pkwy.
Corporate Line of Cincinnati
Cinn. & Ohio R.R.
Crookshank Ave.
Ferguson Rd.
Shirley Pl.
Leona Dr.
Alphonse Ln.
Ponce Dr.
Case Zore Blvd.
Rafiuk St.
Ferguson Pl.
Glenway Ave.
Sidney Dr.
Doreen Pl.
Legend:
Commercial
Industrial
Residential
Multiple Unit Residential
Trailer Court
Open Space
0
400
600
1200
1600
2000
Scale in Feet

FIGURE IV–7 SYLVED LAND USE AND STREETS

TABLE IV-7

CHARACTERISTICS OF SYLVED SAMPLING AREA

Location:	East central portion of Muddy Creek treatment area
Main Streets:	Glenway Ave., Crookshank Rd., Anderson Ferry Rd., Ferguson Rd.
Category:	Residential-Industrial/combined sewers
Size:	Approximately 0.74 sq miles
Population:(a)	3,191 (census); 3,040 (ADL Estimate) 2,668 (I/I Analysis Report)
Residences:	Approximately 630 single-family residences; approximately 75 two- or four-unit residential buildings; 5 six- to eight-unit residential buildings. In addition, there are approximately 50 single unit trailers.(b) Lot size varies from 6,000 to 12,000 sq ft.(c) Age of housing ranges from new to 80 years old(d).

Major Commercial Establishments:(e)(f)

Automobile Related:	4 service stations (554); 7 auto parts/repair (753); 3 auto dealers (551); and 1 car wash (553)
Professional Buildings:	4 realty (65) or insurance (63) offices; 1 veterinarian (074); 1 six-unit professional building
Services:	8 building/plumbing supply establishments (507); 2 moving/storage buildings (4214); 6 hairdressers/barbers (7241); 2 banks (60); 2 drycleaners (7212); 6 miscellaneous service buildings
Retail Stores:	1 hardware (525); 10 specialty (59); 6 food (54); 1 large discount (531); 2 miscellaneous (59)
Eating Places:	5 fastfood (58); 11 restaurant/lounges (58)
Recreational:	4 sports/health establishments; 1 drive-in theater
Institutional Facilities:	1 large vocational school; post office; 1 municipal building
Open Area:	large playing field

Industrial Establishments:(e)(f)

Sheet metal and metal fabricators: 2 - total employment 85 (344)

Box and carton companies: 2 - total employment 30 (26)

Screw machine products: 1 - employment 20 (345)

TABLE IV-7 Continued

Molds, Dies and Tools Companies - 3 - total employment 20 (35)

Truck Cab Mfg: 1 - employment 45 (3713)

Machine Shop: 1 - employment 6 (35)

Gas Lighter Company: 1 - employment 20 (289)

Also: wholesale motor and parts company (37); plate glass company (323); insulation company; sign, heating and seat cover companies, and Greater Cincinnati Bell Telephone Co. office building.

Notes: (a) Population estimates as follows: census--estimated from 1970 census data (estimates required because census blocks do not necessarily coincide with sewer system boundaries); ADL estimate--from staff observations of number of single and multiple housing units and estimated 4 persons/housing unit. I/I Analysis Report--population reported for appropriate subsystem of Muddy Creek from 201 Plan Report.

(b) Estimated from lot counts using sewer maps and from visual observations of ADL staff.

(c) Estimated from sewer system map and visual observations of ADL staff.

(d) Estimated by ADL staff.

(e) Estimated numbers and types of establishments observed by ADL staff on tour of the area. The numbers are not intended to be precise, but to give a relative indication of the type of commercial or industrial activity.

(f) SIC codes are given in parentheses

8. Tap Water

The tap water sample was obtained at the Muddy Creek POTW. With the exception of the village of Addyston, communities in the Muddy Creek treatment area utilize a single water supply operated by the Cincinnati Water Works. The treatment plant is in the eastern part of Cincinnati and withdraws water from the Ohio River for treatment and distribution. Treatment includes: (1) coagulation with alum and additionally (at times) with ferric sulfate; (2) treatment with powdered activated carbon for taste and odor control; (3) settling; (4) sand filtration; and (5) chlorination.

Table IV-8 summarizes the demographic data for the various sampling areas.

TABLE IV-8

SUMMARY DEMOGRAPHIC DATA - MUDDY CREEK - CINCINNATI

	HOUSING			POPULATION			COMMERCIAL		INSTITUTIONAL				INDUSTRIAL		MAJOR SIC CODES		
SAMPLING SITE	No. Single Family	No. Multiple Units	Total Units	1970 Census	ADL* Estimate	I/I** Reprt	Total No.	No. Empl.	No. School	No. Church	No. Munic. Office	Other	No. Estab.	No. Empl.	2-Digit SIC Code	Category	No. Emp
DELFAIR Com-res/sanitary sewer--50-60% older housing	700	Mul 15	715	2856	2832	2505	97	NA	-	1	-	7 prof bldgs (2-6 profs each)	-	-	-	-	-
ELCO old res/combined sewers--variable housing from 80 yrs to new apart. bldgs.	120	Dup 10 Mult 42	172	472	728		63	NA	-	1	-	P.O.	-	-	-	-	-
KIRKRIDGE New res/sanitary sewer--new housing less than 15 yrs, some under construction	253		253	1058	1012	1098	-	-	-	-	-	-					
WEST BOURNE Res/comm/indus/combined sewer--single fam & 2-fam's over 40 yrs	700	dup 135 mult 192	1027	2991	3350	3263	152	NA	4	3	2	cem	6	200	34 26 39	Fab metal Paper & Allied Misc. Manuf	170 26
SYLVED housing variable	630	dup 150 mult 35 trail 50	865	3191	3040	2668	88	NA	1	-	1	p.o. tel.co	17	300	34 37 26 28	Fab metal Trans. Mf Paper Misc Chem	105 45 30 20

*I/I Analysis Report--pop. reported for appropriate subsystem of Muddy Creek from 201 Plan Report.

**ADL estimate--from staff observations and est. 4 persons/housing unit.

V. SAMPLE COLLECTION

A. General Approach

Simultaneous to the development of the sampling plan for use in Cincinnati, decisions were being made as to how the actual collection of the required wastewater volume would be accomplished once field activities began. In general, four alternative approaches were considered during this phase of the planning activity, each of which had both advantages and disadvantages. The four options reviewed included:

- Automated collection with time proportioned compositing
- Automated collection with flow proportioned compositing
- Manual sampling in conjunction with time proportioned compositing
- Manual sampling in conjunction with flow proportioned compositing

Generally, any of these four alternatives appeared appropriate at the outset of our activity, but as planning evolved, several were found to be less attractive than initially conceived.

Of the two sample compositing alternatives (e.g., flow-incremental sample fractions ratioed by flow rate vs. time-incremental sample volumes ratioed on bases of time interval), flow proportioning is more attractive as it takes into account perturbations in flow patterns that may coincide with increased levels (mass basis) of pollutant discharge.

Based upon information obtained from representatives of the municipal sewer district in Cincinnati, it was learned that an estimated 90 percent of the flow that occurs at night (between midnight and 6:00 AM) is caused by infiltration. As it was assumed that infiltration of ground water into the sewage system would not result in the introduction of inordinately high concentrations of the priority pollutants (possibly excluding metallic species) into the system, it was not reasonable to weigh their occurrence with the same degree of importance as the contamination from man-made sources, which presumably happen during the daylight hours. As wastewater flow rates fluctuate during the day, presumably corresponding with the production or utilization of some product, it is preferable to weigh these activities to a representative degree. Whereas time proportioned compositing would weigh each of these periods equally, flow proportioned compositing factors in this variability.

Once the compositing methodology had been determined, the next problem encountered lay in the decision of which type of sample collection (manual versus automated) to employ during the field activity. If a manual sequence was used, the necessity of a labor-intensive field effort arose, as the selected sampling sites were dispersed over the entire area of the Muddy Creek drainage basin. As it was presumed that each collection team could only handle one site per hour (which allowed time for travel between sites, gaining access to the manhole, collecting, preserving and clerical activities), it was determined that two teams per shift would be required to cover the six to eight identified sampling locations frequently (each site once in 3 hours). As 24 hour composites were desirable for this study, this would require that four collection teams be used, working in paired twelve-hour shifts.

The alternative collection method was to employ automated samplers, such as the ISCO model 1680 units. The advantage of this approach was that once these devices were installed, they could be left unattended for extended periods of time, during which they would automatically draw sample from the waste stream.

However, several factors were seen as disadvantages to the usage of automatic samples. Through conversations held with representatives of the Municipal Environmental Research Laboratory (MERL) of the EPA, it was learned that no automatic sampler currently on the market has the ability to collect and retain the volatile organic species that appear on the priority pollutant list. Therefore, if these species were to be collected, a separate grab procedure would have to be conducted periodically throughout the day. Secondly, if the automatic devices were to be set up to collect flow proportioned samples, flow devices such as flumes or weirs would have to be constructed at each sampling location. In addition to this, knowledge of the flow rates through each of the selected manholes would have to be obtained prior to the sampling activity so that the electronics of the sampling unit could be set to collect appropriate sample increments.

Therefore, for the purpose of this pilot study, it was decided that manual collection techniques in conjunction with flow proportioned compositing would be used for sample acquisition. In an attempt to minimize the total number of bottles that would have to be collected, a variability of up to three to one in flow was used as the sampling schedule design basis. In other words, if flows measured during the day varied by a factor of 1 to 3, sufficient volume would be collected in all samples to accurately flow composite. If the variability exceeded this level some compositing approximation would have to be made.

In addition, in an attempt to gain some knowledge describing the use of automatic devices, two sampling points (the POTW influent and the Del Fair site were selected for comparative sample acquisition by use of both manual and automatic techniques.

B. Specific Methodology *

As previously discussed, the majority of all sample collection was conducted utilizing manual techniques. In most instances, the sampling technique of choice coupled a telescoping pole (with an extended length of up to 9.75M (32 ft) to a 2-liter stainless steel graduate (bucket), that was repeatedly lowered into the flow and filled. As required, however, hand dipping of sample volume was also used, specifically in those cases where low flow conditions existed.

---

*Details of each sampling trip are given in Appendix B.

Many factors contributed to the decision of using the telescopic pole and stainless steel bucket combination, foremost among these was a concern for the safety of the sampling personnel. As manholes were normally closed, being opened only at times of maintenance, it was possible for high concentrations of carbon dioxide, carbon monoxide, hydrogen sulfide or natural gas to accumulate within them due to leakage or the decomposition of waste materials. Unless each hole was independently ventilated prior to entry, no guarantee could be made regarding the possible hazards associated with entry. Although sufficient safety precautions could have been imposed, these would have been time consuming, and would have slowed down the entire collection process. Thus, it was decided that as much work as possible would be done from the manhole surface. As necessary, however, provisions were made to safeguard the samplers' well-being during those periods when he or she was forced to enter the manhole to collect the required volume.

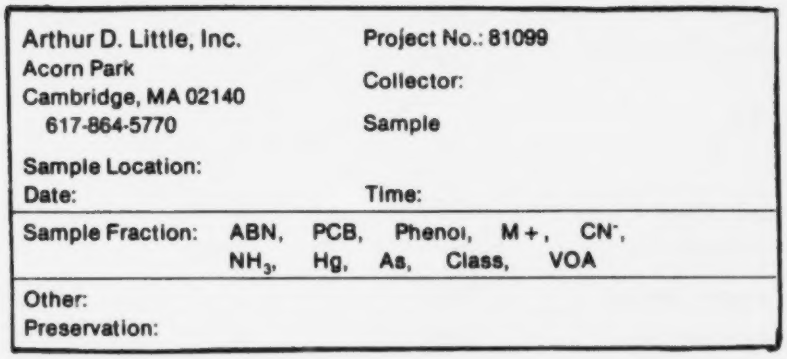
The actual collection of samples from a specific site consisted of several steps. First, one bucket of wastewater was obtained and used for the determination of temperature, pH and the presence of oxidizing species (using KI test paper). After these tests were completed, the waste was disposed of, and several more container volumes were obtained to fill the individual sample bottles required. Depending upon the location and the purpose of the collected sample (regular versus QC), the total volume obtained during each sampling exercise varied. As a minimum, however, each final sample (e.g., those returned to the laboratory for analysis) was comprised of those sample fractions listed in Table V-1 with adequate material available to permit compositing to the listed volumes.

Once the sufficient amount of wastewater had been obtained from each manhole, the next operation undertaken was sample fraction identification, followed by the task of logging them into a field notebook. Each of the collected bottles had a prenumbered label (see Figure V-1) attached which provided room for notations

TABLE V-1

SUMMARY OF FINAL SAMPLE FRACTIONS AND THEIR REQUIRED VOLUMES

Priority Pollutants	Code	Normal Sample	QC Sample
• Acid/Base Neutral fraction	(ABN)	3L	9L
• PCB/Pesticide fraction	(PCB)	1L	3L
• Total Phenol fraction	(Phen)	1L	3L
• Cyanide fraction	(CN)	1L	3L
• Metal fraction	(M+)	1L	3L
• Mercury fraction	(Hg)	1L	3L
• Asbestos fraction	(As)	1L	3L
• Volatile Organic fraction	(VCA)	45mL	45mL
Classical Parameters			
• Ammonia	(NH_3)	1L	1L
• Chemical Oxygen Demand	(COD)	500mL	500mL
• Total Organic Carbon	(TOC)	500mL	500mL
• Biological Oxygen Demand	(BOD)	1L	1L
• Total Suspended Solids	(TSS)	1L	1L
• Oil and Grease	(O+G)	1L	1L



Arthur D. Little, Inc.
Acorn Park
Cambridge, MA 02140
617-864-5770

Project No.: 81099
Collector:
Sample

Sample Location:
Date:
Time:

Sample Fraction: ABN, PCB, Phenol, M +, CN^-, NH_3, Hg, As, Class, VOA

Other:
Preservation:

FIGURE V-1. SAMPLE BOTTLE LABEL

defining its intended purpose (e.g., sample fraction coding), the date of collection, the hour of collection, and the names of people involved in the collection. Once these labels were affixed to each bottle and filled in, all of the same information was transcribed into a laboratory notebook (see Figure V-2), which served as a method of double-checking all information and minimizing labelling inaccuracies. In addition, the sequential number appearing on the label was transcribed onto the cap of each bottle (excluding the volatile fraction screw cap vials where space limitation prohibited this), to preserve sample identity in the event that the label became unattached.

Subsequent to the clerical activities, all samples were preserved as specified within the screening protocol documents and then temporarily packed in ice. Specific instructions detailing sample preservation are outlined in Appendix B.

The last step undertaken at all sampling sites was to determine and record the depth-of-flow of the wastewater. For the purposes of this study, a meter stick was coated with a moisture sensitive grease (Kolor Kut) which changes from yellow to red when it comes in contact with water. The coated meter stick was attached to a telescoping pole and lowered into the path of flow. To insure that the measurement obtained did, in fact, correspond to the depth at the mid-point of the flow channel, each measurement was begun at the extreme edge of each open half-round pipe* and continued until the entire channel had been traversed. The edge of each of the meter sticks used had been beveled in order to minimize the head rise of the flowing water that would have occurred had the edge been left blunt. When the meter stick was removed, the indicated reading was noted and transcribed into the field notebook.

---

*Within a manhole the wastewater flows through an open trough which is a pipe that has been cut in half.

Sample Location:

Date: Time (Military Units):

Collectors:

pH: Temperature: Depth or Flow:

Sample Bottle Number	Sample Fraction Code*	Sample Bottle Number	Sample Fraction Code

*ABN - Acid/Base Neutral
PCB - PCB/Pesticide
Phenol- Total Phenol
M+ - Metals
CN^- - Cyanides
Class/TSS - Total Suspended Solids and BOD

NH_3 - Ammonia, Total Organic Carbon, Chemical Oxygen Demand
Hg - Mercury
As - Asbestos
VOA - Volatiles
Class O+G - Oil and grease

FIGURE V-2. SAMPLE OF LAB NOTEBOOK LOG

By knowing the depth of flow at a given time, in conjunction with several system construction details (pipe size, slope, and material of pipe construction, all of which are obtained from detailed sewer system maps), it became possible to estimate the liquid flow rate within any pipe by use of the Manning equation or from tables derived by use of this equation.

In addition to collecting samples by manual methods, a few samples were also collected using ISCO automated samplers. At one of the field locations (Del Fair), the automatic sampler was set up to obtain a flow proportioned sample of the sewage, while the one set up at the influent to the POTW was set up to collect a time-proportioned sample.

C. On Site Sample Handling and Shipping

At the conclusion of each sampling teams' work cycle, the truck and its contents were returned to the POTW or logistics headquarters for sample transfer and provision re-supply. Once the new team left to continue the sampling process at the remote sites, the logistics team began preparing the collected sample fractions for return shipment to the central laboratory. As dictated by the EPA's screening protocol, three sample fractions (the Acid/Base Neutral fraction, the PCB/Pesticide fraction and the Volatile fraction) were segregated for rapid air shipment back to Boston, while the others were packed and retained on site until such time as they could be trucked to Boston.

As samples were unpacked and divided by collection site and time of collection they were logged into a shipping notebook. One hard copy and one carbon copy of this record was made; the carbon being used as a packing list for the air freight fractions. To insure that no transcribing errors occurred, these lists were cross checked against the collection teams' field notebook before any samples were packaged.

The air freight samples were individually wrapped in bubble wrap and securely packed into styrofoam ice chests. As each chest was filled, crushed ice was placed all around the bottles and the chest sealed. At the conclusion of sample logistics activities, these containers were taken to the airport for shipment. All air freighted samples were returned to Boston and arrived at the laboratory for analytical work-up within 48 hours of the end of the days' collection period. Those samples retained on site (principally those containing preservatives) were packaged in egg-shell type cardboard boxes (to eliminate the need of individual wrapping which is very time-consuming) and then placed in the refrigerated truck that was maintained at 4°C during the entire sampling trip. These samples were returned to the laboratory within three days of the completion of each sampling trip to Cincinnati.

During both sampling trips, an automatic time composited sampler was used at the influent to the POTW. An ISCO Model 1680 sampler equipped with a superspeed peristaltic pump was selected for use at this point. By setting a time interval of 15-20 minutes, with incremental volumes between 200 and 275 mL, it was possible to collect the required sample volume of 19L with a 24-hour period. Since this sample was taken concurrently with the collection of a manual sample at the same point, no volatile species fractions were collected as part of the automatic sample volume.

At Del Fair, the diameter of the sewer line was 38.1 cm (15 in.) accompanied by a line slope of 1.32 percent*. This permitted the use of the ISCO Model 1680 sampler and the ISCO 1700W flow proportioner in concert with a Palmer-Bowles flume as the flow measuring device. Based on average flow values obtained from this site during the first Cincinnati sampling trip at the same site, the logic of the sampler was programmed to collect an increment of approximately 300 mL of wastewater after every 68,130 liters (18,000 gallons) of wastewater flow. Once set up, the sampler was allowed to run unattended for extended intervals (up to 3 hours) before readjustments to the collected volumes or flow intervals were made. These were required in order to collect the desired final volume of wastewater.

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*These geometric considerations are within the acceptable limits for the use of a Palmer-Bowles flume.

At the end of the 24-hour period, or after the required 5 gallons (18.9 liters) of wastewater were collected, the sampler was shut down and refurbished for another sample. All recovered sewage was returned to the POTW for sample fractionation, preservation, and logging in.

The results from the samples collected both ways during the second trip are given in Table V-2. The one paired comparison obtained during the first trip has not been included since the samples were not collected during exactly the same time interval.

Many of the species were observed at the same level in both types of samples. However, there are several cases where the concentrations were substantially different. One major problem with the samples from the autosampler is that they do not maintain the volatiles, which are the species observed most frequently. Based on these data, it is recommended that the manual sampling procedure be used for future studies.

TABLE V-2

COMPARISON OF MANUAL SAMPLING AND AUTOSAMPLER RESULTS

ORGANICS

	POTW Influent				Del Fair			
	Man	Auto	Man	Auto	Man	Auto	Man	Auto
SAMPLE	30	40	43	54	35	41	48	55
Methylene chloride	–	NO VOA	1	NO VOA	42	NO VOA	12	NO VOA
1,1-Dichloroethylene	–		–		–		–	
Chloroform	5		2		6		7	
1,2-Dichloroethane	–		–		–		–	
1,1,1-Trichloroethane	–		1		–		10	
Bromodichloromethane	–		–		5		2	
Dibromochloromethane	–		–		3		3	
Chlorobenzene	–		–		–		–	
Benzene	2		4		1		1	
Ethyl Benzene	–		–		–		–	
Bromoform	–		–		–		–	
1,1,2,2-Tetrachloroethylene	–		3		5		5	
1,1,2,2-Tetrachloroethane	–		–		–		–	
Toluene	–		–		1		4	
Trans-1,2-dichloroethylene	–		–		–		–	
Phenol	–	–	–	–	–	10	–	–
2,4-Dimethylphenol	–	–	–	–	–	–	–	–
Pentachlorophenol	–	–	–	–	–	–	–	–
Naphthalene	–	–	–	–	–	–	–	–
Diethyl phthalate	13	12	21	–	35	18	–	18
Di-n-butyl phthalate	–	–	16	–	12	11	226	187
Bis(2-ethylhexyl)phthalate	–	–	11	–	–	26	163	36
Butyl benzyl phthalate	–	–	–	–	10	12	188	58
Anthracene/Phenanthrene	–	–	–	–	–	–	–	–
Dichlorobenzenes	–	–	–	–	–	–	–	–
Heptachlor	–	–	3	–	–	–	–	–

TABLE V-2 (continued)

COMPARISON OF MANUAL SAMPLING AND AUTOSAMPLER RESULTS
METALS, TOTAL CYANIDES AND TOTAL PHENOLS

	POTW Influent				Del Fair			
	Man	Auto	Man	Auto	Man	Auto	Man	Auto
SAMPLE NUMBER	30	40	43	54	35	41	48	55
Silver	5	5	2	4	-	2	2	-
Arsenic	14	11	14	15	5	7	8	8
Beryllium	-	-	-	-	-	-	-	-
Cadmium	-	8	4	-	-	-	-	-
Chromium	250	37	140	24	-	-	-	-
Copper	72	20	33	25	14	65	31	38
Mercury	-	-	2	-	-	-	-	-
Manganese	310	310	310	320	460	420	440	370
Nickel	98	-	27	-	-	-	44	68
Lead	18	-	13	-	-	-	-	-
Antimony	-	-	-	-	-	-	-	-
Selenium	8	10	11	11	8	9	10	10
Thallium	-	-	-	-	-	-	2	-
Zinc	430	440	230	210	58	110	280	370
Total Cyanides	90	-	-	-	-	-	-	-
Total Phenols	30	22	22	22	42	21	43	38

TABLE V-2 (continued)

COMPARISON OF MANUAL SAMPLING AND AUTOSAMPLER RESULTS

CLASSICAL WASTEWATER PARAMETERS

	POTW Influent				Del Fair			
	Man	Auto	Man	Auto	Man	Auto	Man	Auto
SAMPLE NUMBER	30	40	43	54	35	41	48	55
pH	6.8		6.1		7.4		7.6	
T (^{o}C)	22.9		22.7		24.6		25.1	
Ammonia	12	11	15	12	10	13	11	13
Oil and Grease	20	20	25	25	20	35	65	55
TSS	40	80	110	130	70	100	100	200
TOC	48	60	56	96	66	82	72	124
COD	190	150	180	240	155	265	145	390
BOD	50	35	60	40	55	80	105	125

VI. CHEMICAL ANALYSIS

A. Introduction

The basic procedures used for chemical analysis were those described in the the EPA Screening protocol(1).

Chemical analysis of the samples involved the preparation of a composite sample from the individual field samples, appropriate sample treatment (extraction, etc.),and instrumental analysis. Procedures to monitor the legal chain of custody were followed throughout the preparation, analysis and storage phases.

After the samples arrived from the field, they were composited in the laboratory, using volumetric flow proportioning. An analytical sample was produced for each time period and sampling site. The composited samples were subsequently divided into aliquots for sample preparation and analysis. Aliquots were produced for nine categories of priority pollutants. The categories included priority pollutants which were amenable to analysis by a specific analytical method. The categories of compounds for which the composited sample was analyzed and the aliquot volume are indicated in Figure VI-1. The aqueous aliquots taken for analysis of the Volatile, Acid,and Base/Neutral categories were spiked with internal standards prior to sample preparation by purge and trap or liquid/liquid extraction techniques. Table VI-1 also lists the categories of priority pollutants and the laboratory code indicating the compound category and the concentrations of the internal standard(s) spiked into the samples in a particular category.

All of the details of the current procedures are not in the March/April 1977 Screening document(1). Revisions used in this program were obtained from discussions with EPA personnel and contractors concerned with the analysis of priority pollutants(5,6); EPA technical seminars(7,8); and EPA technical memoranda(2).

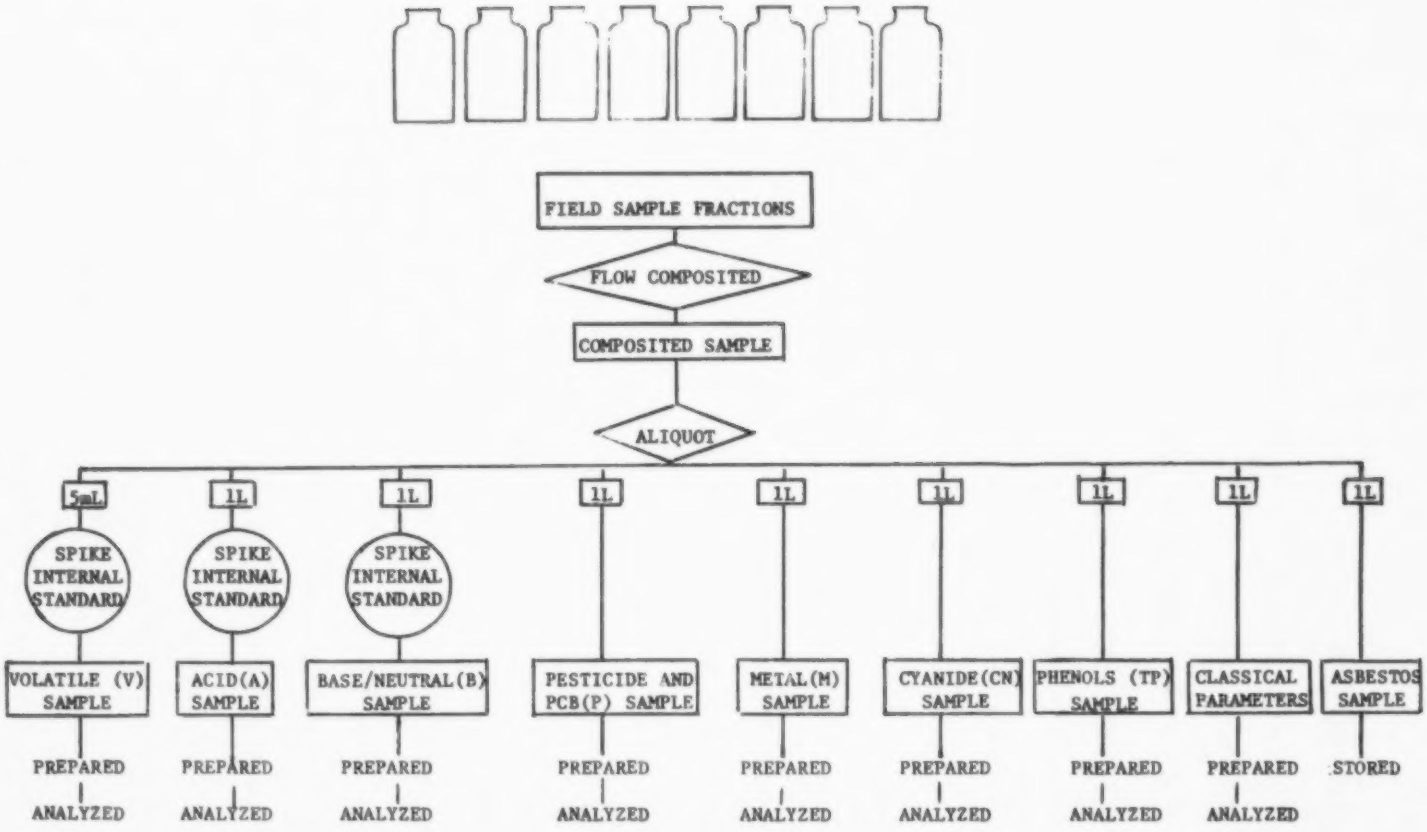
FIELD SAMPLE FRACTIONS
FLOW COMPOSITED
COMPOSITED SAMPLE
ALIQUOT
5mL
1L
1L
1L
1L
1L
1L
1L
1L
SPIKE INTERNAL STANDARD
SPIKE INTERNAL STANDARD
SPIKE INTERNAL STANDARD
VOLATILE (V) SAMPLE
ACID(A) SAMPLE
BASE/NEUTRAL(B) SAMPLE
PESTICIDE AND PCB(P) SAMPLE
METAL(M) SAMPLE
CYANIDE(CN) SAMPLE
PHENOLS (TP) SAMPLE
CLASSICAL PARAMETERS
ASBESTOS SAMPLE
PREPARED
ANALYZED
PREPARED
ANALYZED
PREPARED
ANALYZED
PREPARED
ANALYZED
PREPARED
ANALYZED
PREPARED
ANALYZED
PREPARED
ANALYZED
PREPARED
ANALYZED
STORED

FIGURE VI-1: ANALYSIS SAMPLE FLOW CHART

TABLE VI-1

PRIORITY POLLUTANT ANALYSIS CATEGORIES

Priority Pollutant Category	Laboratory Code	Internal Standard Compound	Internal Standard Final Concentration (μg/L)
Volatiles	V	bromochloromethane 2-bromo-1-chloropropane 1,4-dichlorobutane	20 20 20
Acids	A	D-10-Anthracene	5
Base/Neutrals	B	D-10-Anthracene	5
Pesticides/PCB's	P		
Total Cyanides	CN		
Total Phenols	TP		
Metals	M		
Asbestos	AS		
Classical Parameters			

B. Analytical Procedures

The following are brief descriptions of the methods by compound category. Appendix C gives a more detailed description.

Volatiles

The Volatile category includes 32 priority pollutant compounds. The sample was prepared for analysis by the purge and trap technique. A 5ml sample aliquot was purged with helium gas onto a sorbent trap. The trapped volatiles were subsequently thermally desorbed from the sorbent trap onto a Carbopack gas chromatographic column. The identification and quantification of the compounds were achieved by using an automated gas chromotograph/mass spectrometer instrument (GC/MS).

Acids

The Acid category includes 12 priority pollutant compounds. The 1L sample aliquot was prepared for analysis by extraction into a methylene chloride solvent at pH less than 2. The extract was concentrated to a known volume and chromatographed with an acid deactivated polyester (Supelco's 1% SP 1240DA)(2) gas chromatographic column interfaced with the GC/MS.

Base/Neutrals

The base/neutral category includes 48 priority pollutant compounds. The 1L sample aliquot was prepared for analysis by extraction into methylene chloride at a basic pH greater than 11. The extract was concentrated to a known volume and chromatographed onto a methyl-phenyl silicone (Supelco's 1% SP2250) gas chromatographic column interfaced with the GC/MS.

Pesticides and PCBs

The Pesticide and PCB category includes 23 priority pollutant compounds. The 1L sample aliquot was prepared by extraction into 15% methylene chloride/85% hexane. The extract was separated using liquid adsorption chromatography on florisil. The eluents were concentrated to a known volume and chromatographed onto a methyl-phenyl silicone/trifluoropropyl silicone (Supelco's 1.5% SP2250/1.95%SP2401) gas chromatographic column interfaced with an electron capture detector (GC/ECD). Pesticides and PCBs were quantified using the GC/ECD system, and a preliminary identification was obtained by comparing retention times with known compounds. Any pesticides and PCBs tentatively identified were confirmed using GC/MS techniques.

Total Cyanides

The sample aliquot was prepared by distillation. The distillate was reacted with chloramine T to produce a dye complex. The absorbance of the sample was determined, using colorimetric procedures.

Total Phenols

The sample aliquot was prepared by a distillation technique. The distillate was reacted with 4-aminoantipyrine to produce a dye complex. The complex was extracted into chloroform. The absorbance of the sample was determined using colorimetric procedures.

Metals

The metal category included 15 priority pollutant elements. The sample aliquot was prepared by an acid digestion technique. The elements were analyzed, using atomic absorption spectrophotometry.

Asbestos

The 1L sample aliquots for asbestos analysis were preserved with mercuric chloride and stored at 4°C.

Classical Parameters

Appropriately perserved sample aliquots were analyzed for total suspended solids (TSS),biochemical oxygen demand (BOD), chemical oxygen demand (COD), total organic carbon (TOC), ammonia (NH_3), and oil and grease (OG).

The reporting limits for the organic and inorganic priority pollutants can be found in Appendix C. In the Volatile, Acid, and Base/Neutral categories, the limits are listed for samples from the first and second trips to the Cincinnati area. The reporting limits for the inorganic priority pollutants in the metals category were the same for the first and second trips to Cincinnati; however, the limits were different for method reference standards and raw wastewater spikes, and are listed to indicate that difference. The total cyanides' method had a reporting limit of 20 µg/L. The total phenols' method had a reporting limit of 10 µg/L.

Data on the field blanks shown in Table VI-2 indicate that the contamination issue is in control, with the possible exception of a few elements or compounds.

It is not at all clear what the total phenols values mean for these samples since the only phenol observed in the GC/MS analysis was phenol itself and there is no correlation between the two sets of values. It is felt that the apparent total phenol value is derived from some interfering species present only in the raw wastewater. These results are discussed further in Section VIII.

There were some compounds which were consistently not detected, using the EPA screening protocol.(1) The compounds are listed in Table VI-3. In the Volatile category, the compounds which were not detected apparently broke through the Tenax/Silica gel trap. In the Base/Neutral category, bis-chloromethyl ether has a short half-life(1) in water, and was therefore not detected. It is not known why hexachlorocyclopentadiene was not detected. In the Pesticides and PCB category, the method was not selective enough to analyze for chlordane, toxaphene and the PCBs, when they are present at the same concentration level as the other pesticides.

Complete data from the chemical analyses have been tabulated by sample number, site location, and chemical compound in Appendix E through Appendix G.

TABLE VI-2

FIELD BLANKS

Organics

SAMPLE	19	20	42	65				Avg.
Methylene chloride	–	>100	14	–				
1,1-Dichloroethylene	–	–	–	–				–
Chloroform	–	–	4	1				1
1,2-Dichloroethane	–	–	–	–				–
1,1,1-Trichloroethane	–	–	–	–				–
Bromodichloromethane	–	–	–	–				–
Dibromochloromethane	–	–	–	–				–
Chlorobenzene	–	–	–	–				–
Benzene	–	–	–	–				–
Ethyl Benzene	–	2	–	–				0.5
Bromoform	–	–	–	–				–
1,1,2,2-Tetrachloroethylene	–	–	–	–				–
1,1,2,2-Tetrachloroethane	–	–	–	–				–
Toluene	–	–	–	–				–
Trans-1,2-dichloroethylene	–	–	–	–				–
Phenol	–	–	–	–				–
2,4-Dimethylphenol	–	–	–	–				–
Pentachlorophenol	–	–	–	–				–
Naphthalene	–	–	–	–				–
Diethyl phthalate	–	–	–	–				–
Di-n-butyl phthalate	–	–	–	–				–
Bis(2-ethylhexyl)phthalate	–	–	19	–				5
Butyl benzyl phthalate	–	–	–	–				–
Anthracene/Phenanthrene	–	–	–	–				–
Dichlorobenzenes	–	–	–	–				–
Heptachlor	–	–	–	–				–

TABLE VI-2 (Cont'd)

FIELD BLANKS

Metals, Cyanides and Phenols

SAMPLE NUMBER	19	20	42	65				Avg.
Silver	–	3	1	–				1
Arsenic	–	–	10	3				3
Beryllium	–	–	–	8				2
Cadmium	–	–	–	–				–
Chromium	–	–	–	–				–
Copper	16	12	–	–				7
Mercury	–	–	–	–				–
Manganese	–	23	–	11				8
Nickel	12	28	–	–				10
Lead	23	–	–	7				7
Antimony	–	6	–	–				1
Selenium	–	–	6	6				3
Thallium	–	–	–	–				–
Zinc	62	–	–	28				22

Total Cyanides	–	–	–	–				–

Total Phenols	16	37	–	–				13

TABLE VI-3

STANDARDS NOT DETECTED BY THE EPA METHOD

Volatiles

Chloromethane
Bromomethane
Vinyl Chloride
Dichlorodifluoromethane

Base/Neutrals

Bis-chloromethyl ether
Hexachlorocyclopentadiene

Pesticides and PCB's

Chlordane
Toxaphene
Arochlor -1016, -1242, -1248, -1254, -1260

VII. QUALITY ASSURANCE/QUALITY CONTROL

A. Program

A quality assurance program was established for this study in order to be able to document the reliability of the data obtained on pollutants found in the samples. The specific quality control (QC) activities for sample analysis were based on the general recommendations published by EMSL/EPA Cincinnati as specifically abstracted for this type of program in a March 1978 document. The specific recommendations made in the March document were designed primarily for studies in the verification phase of effluent surveys. The procedures were modified somewhat in order to be able to adapt them to the Screening analysis. The important difference for QC in the two types of analysis activities (Screening and Verification) is that all pollutants must be studied for Screening, not just a few, and that the sample pollutant concentration level is not known. The latter factor leads to a requirement to estimate what the appropriate spiking levels will be before the analyses are done. The final procedures used in this study evolved from discussions with the Project Officer and the EPA Quality Assurance Advisor.(5,6)

For each of the two field sampling trips, nine samples (representing a range of source types) were chosen as quality control samples. Three quality control samples were taken each day of the three-day study. Upon receipt in the laboratory, each QC sample was split into three aliquots for each analysis category. Two aqueous aliquots were spiked in duplicate with a solution containing a known concentration of the appropriate standards for that category. These spiked aqueous aliquots were labeled "A" and "B". The third unspiked aqueous aliquot of raw wastewater was analyzed as the unknown, "C". All spiking of priority pollutant standards and internal standards were done prior to sample preparation. The samples associated with the quality control activities are shown in Figure VII-1.

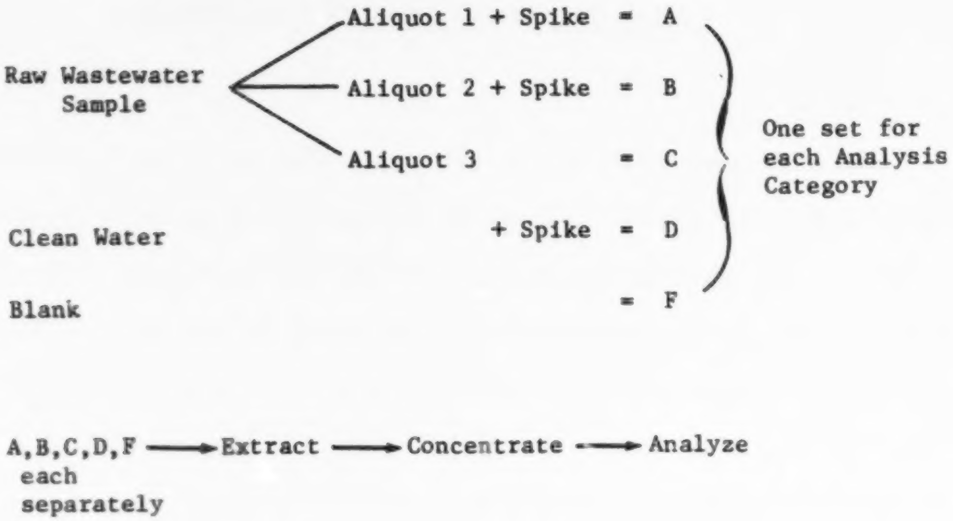
Raw Wastewater Sample
Aliquot 1 + Spike = A
Aliquot 2 + Spike = B
Aliquot 3 = C
Clean Water
+ Spike = D
Blank
= F
One set for each Analysis Category
A,B,C,D,F each separately
Extract
Concentrate
Analyze

FIGURE VII-1. DESCRIPTION OF QUALITY CONTROL SAMPLES

The original EPA QA protocol's calculations were based on replicate raw wastewater "unknown" results and not replicate spikes. In addition, the spike concentration levels for recovery calculations were recommended at twice the level of the unknown value, or 5-10X the detection limit. The modified procedure was used in this program in order to obtain data for all the priority pollutants, rather than just the priority pollutants found in the samples.

Associated with the three sample aliquots was a spiked method reference standard, labeled "D". This standard was an aliquot of "Milli-Q" water (i.e., distilled and deionized water which has been carbon-filtered to remove organics). The method reference standard was spiked with the standard spiking solution at the same concentration level as "A" and "B".

Method blanks labeled "F" and consisting of unspiked Milli-Q water, were also extracted, concentrated and analyzed for each compound category, on a daily basis.

Extraction, concentration and analysis procedures followed for the QC samples were given in Section VI.

In order to determine actual priority pollutant values for the unknowns, and recoveries of the spiked samples, calibration standards covering the projected range were prepared and analyzed. From these known values, a calibration curve was prepared for each compound, relating the measured variable (area, absorbance, etc.) to the concentration. The calibration data was gathered throughout the period of analysis of samples in that category. Thus, daily calibration checks were included in the calibration curves.

A typical chromatogram and calibration curve for a single compound in each analysis category has been included in Appendix C.

Statistical data for each priority pollutant spiked into the QC samples were gathered on the first 15 complete QC sets (A, B, C, D and F, if applicable).

Table VII-1 summarizes the symbols and formulas used to calculate recoveries, critical ranges, and standard deviations. Details of the procedures are given in Appendix D.

The following sample calculation is included to demonstrate the calculation procedures.

A quality control sample was analyzed and gave the following results:

Designation	Letter Code	Observed Value O_i	"Unknown" Value	O_i -"Unknown"= X_i	Mean of Pair= $\overline{X}_i$	Range of Pair= R_i
Replicate Spikes of raw wastewater	A	60	12 =	48	45	6
	B	54	12 =	42		
"Unknown" value	C	12		n.a.		
Method Reference Standard	D	52		n.a.		
Blank	F	0		n.a.		

The individual percent recoveries, based on the theoretical spiked-in values were:

	O_i (or X_i)	T_i	P_i, %
A	48	50	96
B	42	50	84
D	52	50	104

Mean percent recoveries and standard deviations were calculated for the 15 method reference standards and 30 (15 pairs) raw wastewater spikes.

The critical range (R_c) value was determined after summing 15 individual R_i and $\overline{X}_i$ values.

For most of the pollutants, the decisions made regarding the levels to spike the samples with worked well throughout the study. The major exception

TABLE VII-1

EXPLANATION OF SYMBOLS AND CALCULATION OF DATA

Symbols used on the data sheets are defined below:

A = Raw wastewater, spiked

B = Raw wastewater, spiked as replicate of A

C = Unknown = raw wastewater, unspiked

D = Method reference standards
= Milli-Q water, spiked at same level as A and B

F = Method blank
= Milli-Q water, unspiked

O_i = Observed value, µg/L

T_i = True (theoretical) value, µg/L

X_i = (Observed value, µg/L) - (unknown value, µg/L)

$P_i(\%) = \frac{100\ (O_i)}{T_i}$ = Percent Recovery

$\overline{X}_i$ = Mean of replicate spikes A and B, $= \frac{X_i\ (A) + X_i\ (B)}{2}$

R_i = Range of replicate spikes A and B
$= |X_i\ (A) - X_i\ (B)|$

n = Number of data points

n* = Number of paired samples

C = Spike concentration, µg/L

R_c = Critical range for a specific concentration, $= \frac{3.27\ (C) \sum_{i=1}^{n} R_i}{\sum_{i=1}^{n} \overline{X}_i}$

$\overline{P}$ = Mean Percent Recovery $= \frac{\sum_{i=1}^{n} P_i}{n}$

S_p = Standard deviation of percentage recovery

$$= \sqrt{\frac{\sum_{i=1}^{n} (P_i - \overline{P})^2}{n - 1}}$$

$\%S_p$ = Relative standard deviation of percentage recovery

$$= \frac{100\ (S_p)}{\overline{P}}$$

was for the metals. The preliminary decision for the metals was to spike at 5-10X the detection limit per the general recommendations, but using instrument manufacturers' optimistic descriptions of detection limits. For the detection limits actually achieved for the metals in the raw wastewater samples, this meant that in many cases the metals had been spiked at levels equal to or less than the detection limit. Further, several metals were found at levels significantly higher than the detection limit and/or spiking level. Therefore, in order to represent the precision of the metals analysis an alternative procedure was used to calculate precision, in addition to following the normal calculation procedure--which was inappropriate for most of the metals data because of the levels at which the samples had been spiked. Details of the alternative calculation procedures for the metals are also given in Appendix D. A description of the alternate definitions used for this case is given in Table VII-2.

B. Results

The quantative results for each pollutant studied are detailed in Appendix D. Data was not obtained for some of the compounds because it was not possible to obtain reference supplies of all the priority pollutants before conducting the study. The exception is for those few compounds for which the recommended protocol is problematic; these have been discussed in Appendix C. Due to the detailed quality control program, these problems were able to be traced back to specific technical difficulties with the purge and trap, chromatography or contamination.

For further convenience in reviewing this data, Table VII-3 has been prepared summarizing the overall results achieved within each of the analysis categories.

TABLE VII-2

DESCRIPTION OF SYMBOLS AND CALCULATIONS OF DATA FOR METALS

Raw Wastewater Spikes

n = number of duplicate sets

$\bar{\bar{X}}$ = the mean of the duplicate mean measured values

= $\sum_{i=1}^{n} \bar{X} / n$

$S_p(\bar{\bar{X}})$ = Standard deviation of $\bar{\bar{X}}$

$\bar{R}$ = the mean of the calculated ranges (R_i) for the duplicate sets

= $\sum_{i=1}^{n} R_i/n$

$S_p(\bar{R})$ = the standard deviation of $\bar{R}$

RP,% = range percentage of the mean measured value ($\bar{X}$)

= $R_i/X \times 100$

$\overline{RP}$ = the mean of RPs

= $\bar{R}/\bar{\bar{X}} \times 100$

Method Reference Standards

n^* = number of samples

$\bar{P}$ = mean percentage recovery

S_p = the standard deviation of $\bar{P}$

% S_p = the relative standard deviation

TABLE VII-3

QUALITY CONTROL RESULTS SUMMARY

		Method Reference*			Raw Wastewater*		
Category	Average Spiking Level, μg/L	Average Recovery		Average Standard Deviation	Average Recovery		Average Standard Deviation
Volatiles	20	87	±	23	80	±	31
Acids	50	89	±	26	95	±	22
Base/Neutrals	50	100	±	33	84	±	25
Pesticides and PCBs	30	73	±	11	69	±	14
Total Cyanides	20	103	±	3	101	±	12
Total Phenols	60	107	±	13	93	±	15
Metals	10	115	±	71	NA	±	17

*Average of all mean percentage recovery values for each compound and average of all mean percentage recovery standard deviations for each compound.

For a screening methodology, the overall results are very good. Most recovery values are in the 80-100% range and the precision is about 25-30%. It is particularly significant that the results are about the same for each analysis category, showing lack of any particular procedural bias. Further, when the results within a category are reviewed, each of the compounds has about the same results as the average, showing that the same sort of accuracy is possible independent of specific compound type. This factor will be important in speculating as to the likely results to be achieved with any new compounds to be added to the list in the future.

It is worth noting the results on some compounds in particular. Acrolein and acrylonitrile were done by the purge and trap procedure--acrolein shows a 24% recovery from RWW but still only with a 29% standard deviation and acrylonitrile shows a 98% recovery with a 24% standard deviation.

The acids have generally been somewhat problematic in the protocol for everyone using the procedure, but the results achieved in this program are very good. Two exceptions in the category are phenol and 4-nitrophenol which show lower recovery--77% and 56% from clean water and 62% and 21% from RWW, respectively. Theoretical extraction efficiencies were calculated for these and a few of the other phenols using partition coefficient data available for chloroform, since methylene chloride data was not available. The calculated possible maximum recovery and observed results are compared below:

Compound	Calculated Recovery	Observed Recovery MRS	Observed Recovery RWW
Phenol	54	77	62
4-Nitrophenol	51	56	21
2-Chlorophenol	95	86	93
2,4,6-Trichlorophenol	100	98	108

These calculations show that the results obtained for phenol and 4-nitrophenol are the best that can be expected from the procedure. The chlorophenols were included in the list to check the calculation procedures.

The most appropriate indication of method performance for the metals is given in Table D-11, using the alternate calculation procedures. The metals as a group generally show the higher overall variability. Most of the work with the metals was done close to or at the detection limits, whereas most of the organics data was obtained at levels about five times the detection limit. For future studies it is recommended that the metals be spiked at the levels indicated in Table VII-4. The recommended levels are based on a combination of results obtained on the samples from the Cincinnati study and the detection limits. We have also recommended that several of the elements be analyzed by DC plasma emission spectrometry (PES) for reasons of economy and equipment availability and because results comparable to or better than AAS can be obtained with the PES.

The acceptable recovery range for future method reference standards will be the mean percent recovery for the 15 QC samples plus or minus twice the standard deviation. Acceptable recovery ranges for raw wastewater spikes must be the mean percent recovery for the 15 QC samples plus or minus three times the standard deviation. In addition, individual ranges, R_i, must be less than the established critical range, R_c, based on the 15 QC sample results. A final concluding note on the results achieved is that it would not have been possible to obtain the quality of data that was achieved if a quality control program had not been used.

TABLE VII-4

RECOMMENDED QUALITY CONTROL SPIKING LEVELS (μg/L) FOR METALS

	Detection[1] Limits	Recommended[2] Spike	Recommended[3] Procedure
Silver	3	10	FAAS
Arsenic	4	25	FAAS
Beryllium	3	10	FAAS
Cadmium	3	10	FAAS
Chromium	27	100	PES (2)
Copper	9	50	PES (1)
Mercury	6	10	FAAS
Manganese	11	100	PES (10)
Nickel	1	50	PES (10)
Lead	9	50	PES (10)
Antimony	2	10	FAAS
Selenium	1	10	FAAS
Thallium	1	10	FAAS
Zinc	12	100	PES (5)

[1] determined from RWW, AAS and FAAS

[2] based on 5-10X detection limit and observed sample levels

[3] PES recommendation based specifically on use of ADL Spectrometrics Spectraspan II DCPES, detection limits in parentheses

VIII. DISCUSSION OF RESULTS

The detailed description of the samples obtained from the two trips to Cincinnati and the results of the chemical analyses are given in Appendix E. Parts of that data are summarized in this section.

The average flow data observed for each day/location are given in Table VIII-1. Flow data for the individual sites were obtained with the meter stick and Manning formula approach described earlier, while data for the flow at the influent was obtained from the plant meter. The source flows are relatively reliable but may be in error on the high side by a factor of two. The listed flows indicate that the source locations studied account for 80% of the POTW influent. The flow data will be examined more closely by reviewing the water use and discharge records. A more probable estimate would be that they contribute 30-40% of the influent flow. Weather data for Cincinnati during the sampling period have been included in Table VIII-2. Pollutant concentrations may have been affected by the amount of precipitation measured on August 10.

It is premature to attempt a very detailed interpretation of the data from a single POTW district, but it is constructive to briefly review some of the data. (A complete and thorough interpretation of observations and factors will be done with the data from all of the districts finally studied.)

The average data from all of the samples for each location have been calculated and are shown in Table VIII-3. Tabulation of the complete analytical data by site location is given in Appendix F. For convenience, an abbreviated description of the sites is outlined in

TABLE VIII-1

LOCATION FLOW DATA

Location	Flow* (Liters per Second)						
	8/8	8/9	8/10	9/8	9/9	9/10	Avg.
Tap Water	-	-	-	-	-	-	
POTW Influent	382	373	365	427	532	480	427
Kirkridge	37	32	22	-	23	30	29
St. George	-	-	-	59	28	-	44
Elco	20	12	11	35	38	24	23
Del Fair	-	-	36	25	24	33	30
West Bourne	34	38	29	60	51	52	44
Sylved	-	-	-	138	112	95	115

*daily average

TABLE VIII-2

WEATHER DATA FOR CINCINNATI DURING SAMPLING PERIODS

Date	Precipitation (inches)	Temperature (°F)			
		8 am	8 pm	high	low
Aug. 8	0	61	77	81	59
9	0	70	79	84	68
10	0.20	69	76	78	68
11	0	67	77	79	66
Sept 8	0	62	79	87	61
9	0	62	79	88	60
10	0	65	78	87	64
11	0	65	76	84	64

Air Quality Index

Aug. 8 - 107, "unhealthful"; Aug. 9 - 99, moderate; Aug. 10 - 77, moderate; Aug. 11 - 59, moderate

Sept. 8 - 109, "unhealthful"; not reported; Sept. 11 - 104, "unhealthful"

TABLE VIII-3

AVERAGE CONCENTRATION VALUES (μg/L) ORGANICS

	TAP WATER	POTW INF.	KIRKRIDGE	ST. GEORGE	ELCO	DELFAIR	WEST BOURNE	SYLVED
Chloroform	40	3	2	12	3	6	4	3
1,2-Dichloroethane	–	0.5	–	–	–	–	0.7	–
1,1,1-Trichloroethane	–	0.3	–	–	0.7	2	4	–
Bromodichloromethane	17	–	–	10	0.2	2	1	–
Dibromochloromethane	15	–	–	7	0.2	2	0.7	–
Chlorobenzene	–	–	–	–	1	–	–	–
Benzene	–	4	–	1	0.2	0.5	3	–
Ethyl Benzene	0.2	1	0.2	–	2	3	4	–
Bromoform	2	–	–	2	–	–	–	–
1,1,2,2-Tetrachloroethylene	–	1	0.5	0.5	3	7	3	3
1,1,2,2-Tetrachloroethane	–	1	–	–	0.5	–	–	–
Toluene	–	2	0.8	–	6	6	18	1
Trans-1,2-dichloroethylene	–	–	–	–	–	0.3	–	–
Phenol	–	–	2	–	20	5	4	–
2,4-Dimethylphenol	–	–	–	–	0.7	–	–	–
Pentachlorophenol	–	4	–	6	–	–	–	–
Naphthalene	–	4	–	–	2	1	3	–
Diethyl phthalate	3	12	19	5	31	13	16	8
Di-n-butyl phthalate	14	12	19	44	13	36	20	11
Bis(2-ethylhexyl)phthalate	16	4	7	28	12	24	15	6
Butyl benzyl phthalate	–	–	7	–	6	14	6	–
Anthracene/Phenanthrene	–	–	–	–	–	–	–	–
Dichlorobenzenes	–	–	–	–	–	3	–	8
Heptachlor	–	0.5	–	–	–	–	0.3	–

TABLE VIII-3 (Cont'd.)

AVERAGE CONCENTRATION VALUES (µg/L)

METALS, TOTAL CYANIDES AND TOTAL PHENOLS

	TAP WATER	POTW INF.	KIRKRIDGE	ST. GEORGE	ELCO	DELFAIR	WEST BOURNE	SYLVED
Silver	1	4	1	15	0.4	2	1	3
Arsenic	6	23	19	4	16	9	8	14
Beryllium	-	-	-	-	-	-	-	-
Cadmium	2	2	-	-	1	2	2	1
Chromium	10	158	7	-	17	-	-	-
Copper	28	66	144	735	107	36	60	39
Mercury	-	0.3	-	-	0.3	-	0.3	-
Manganese	7	347	81	27	132	457	320	367
Nickel	13	42	-	-	10	15	25	13
Lead	-	20	5	95	51	3	35	8
Antimony	-	-	-	-	3	2	-	1
Selenium	4	5	4	11	6	5	1	11
Thallium	-	-	-	-	-	0.3	0.5	-
Zinc	44	392	131	193	134	141	142	157

Total Cyanides	-	41	-	-	-	-	-	-

Total Phenols	8	25	28	53	58	37	36	27

TABLE VIII-3 (Cont'd)

AVERAGE VALUES

CLASSICAL WASTEWATER PARAMETERS (mg/L)

	TAP WATER	POTW INF.	KIRKRIDGE	ST. GEORGE	ELCO	DELFAIR	WEST BOURNE	SYLVED
pH	7.2	6.9	7.2	8.4	7.5	7.5	7.3	7.4
T (°C)	24.4	22.6	21.6	31.8	23.3	24.0	25.1	22.9
Ammonia	0.1	14	24	<3	22	14	15	11
Oil and Grease	—	63	64	18	351	386	134	23
TSS	1	103	156	110	403	133	131	88
TOC	4	49	92	540	99	83	70	70
COD	—	186	283	1400	318	255	237	183
BOD	—	48	121	670	151	107	93	70

Table VIII-4. Table VIII-3 lists only those chemicals which were found in at least one of the locations. Twenty-four organic pollutants were found. Thirteen of the fourteen metals were found at least once; beryllium was not found. All of the other priority pollutants were not found, with the exception of asbestos which was not analyzed. Data for days which were sampled in 12/12 hour or 18/6 hour increments were calculated by flow proportioning the period data.

Perhaps the single most important observation in the data is that very few of the priority pollutants were found in the Muddy Creek district and those found were generally at a very low level, often close to the detection limit. Some pollutants were recorded very few times in the 24 hour composites. To provide some perspective on the occurrence, graphs were prepared (Figure VIII-1) showing the number of times each chemical was observed. Of the twenty-four observed organics, ten were observed less than five times, always at low concentrations. Metals that were observed less than five times were also found to be close to the detection limit.

Figure VIII-2 clearly illustrates the relationship between the frequency of detection in the 24 hour composites, and the average concentration for the observed compounds. Of the organics, only di-n-butyl phthalate, bis(2-ethylhexyl) phthalate, and diethyl phthalate were found above 10 μg/L in more than 50% of the samples. On the other hand, five of the metals--manganese, copper, zinc, arsenic and lead--were all found above 10 μg/L in at least 50% of the samples.

In contrast to the phthalates and the metals that were detected in almost all sources, there are other chemicals that were occasionally present at relatively high levels, indicating that the source categories and activities are recognizably different when considered in terms of

TABLE VIII-4

SITE DESCRIPTION - CINCINNATI

Location	Sewer		Residential		Commercial	Industrial	Avg. Flow(Lps)
	Sanitary	Combined	New	Old			
Tap Water			(not applicable)				
POTW Influent			(not applicable)				427
Kirkridge	X		X				28
St. George		X		(Hospital Only)			44
Elco		X		X			23
Del Fair	X			X	X		30
West Bourne		X		X	X	X	44
Sylved		X		X		X	115

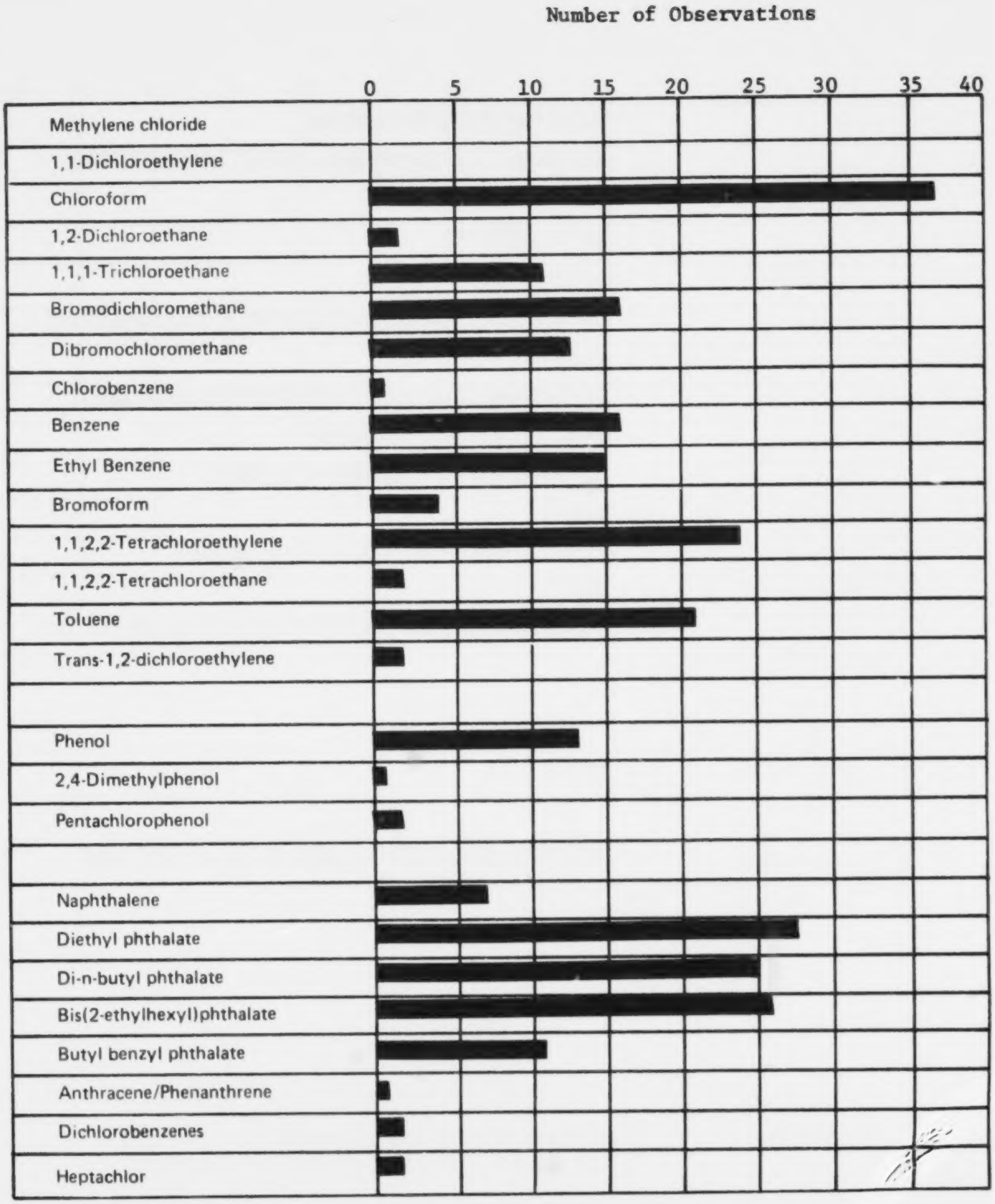

FIGURE VIII–1 FREQUENCY DISTRIBUTION OF OBSERVED POLLUTANTS ORGANICS

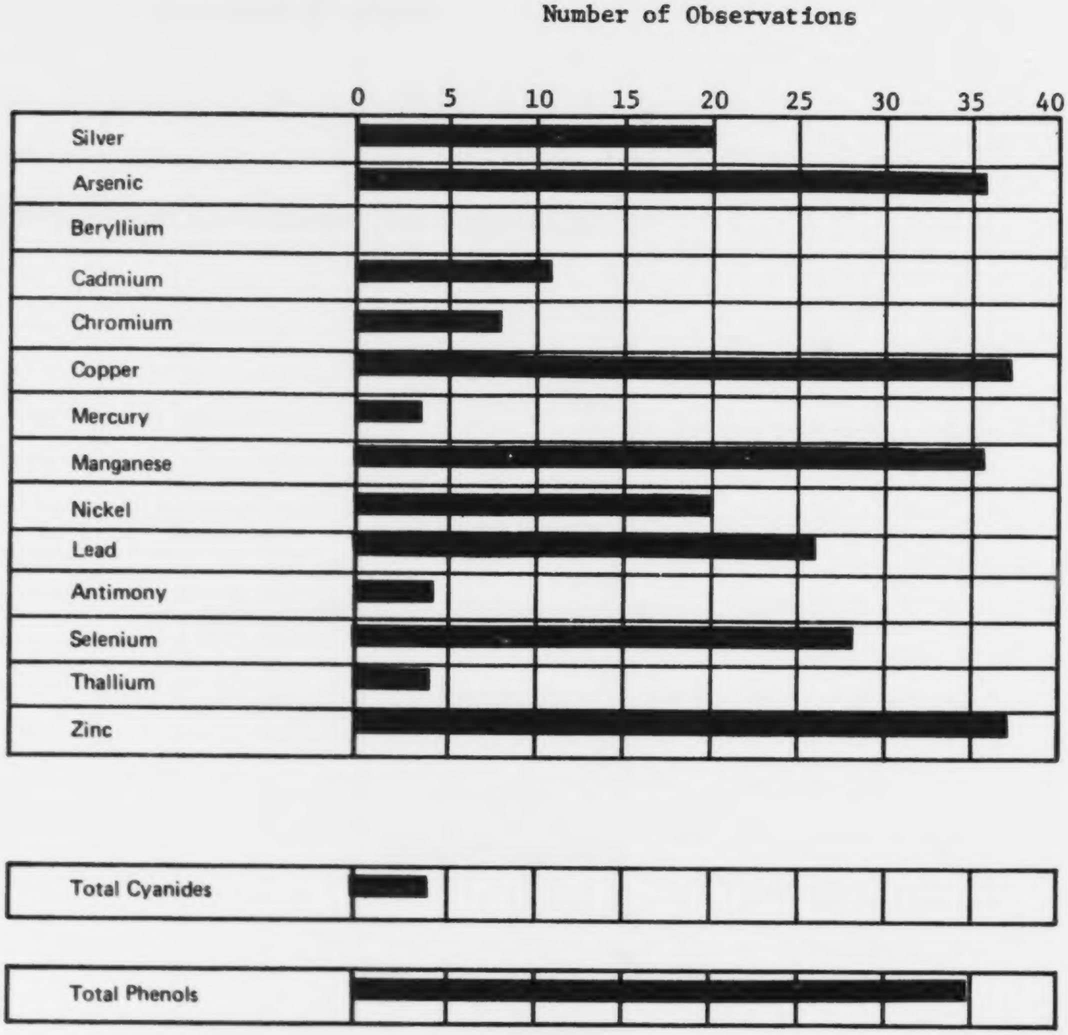

FIGURE VIII–1 (Cont'd) FREQUENCY DISTRIBUTION OF OBSERVED POLLUTANTS METALS, TOTAL CYANIDES AND TOTAL PHENOLS

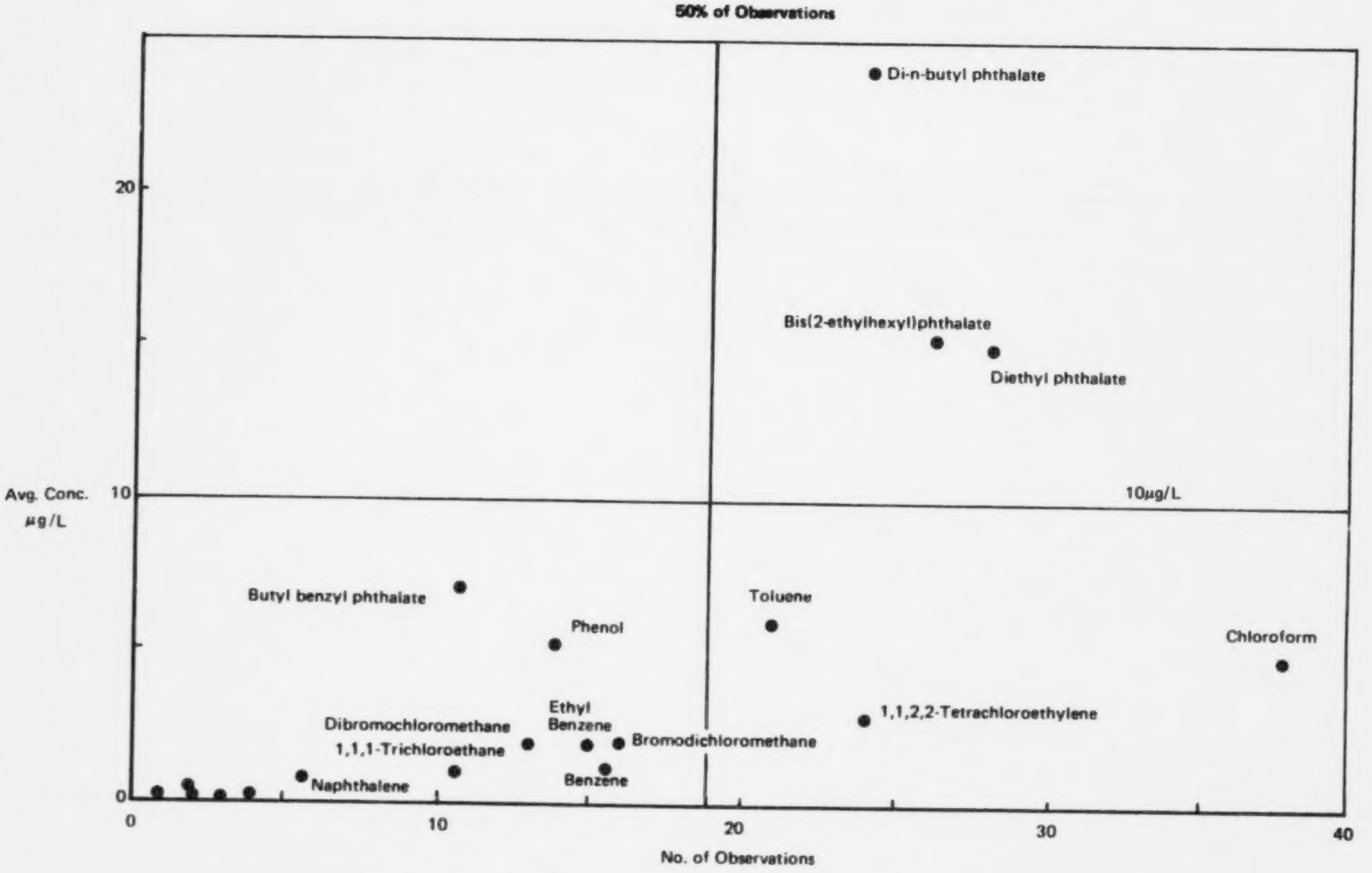

FIGURE VIII–2 FREQUENCY OF OBSERVATIONS AND AVERAGE CONCENTRATIONS OF PRIORITY POLLUTANTS

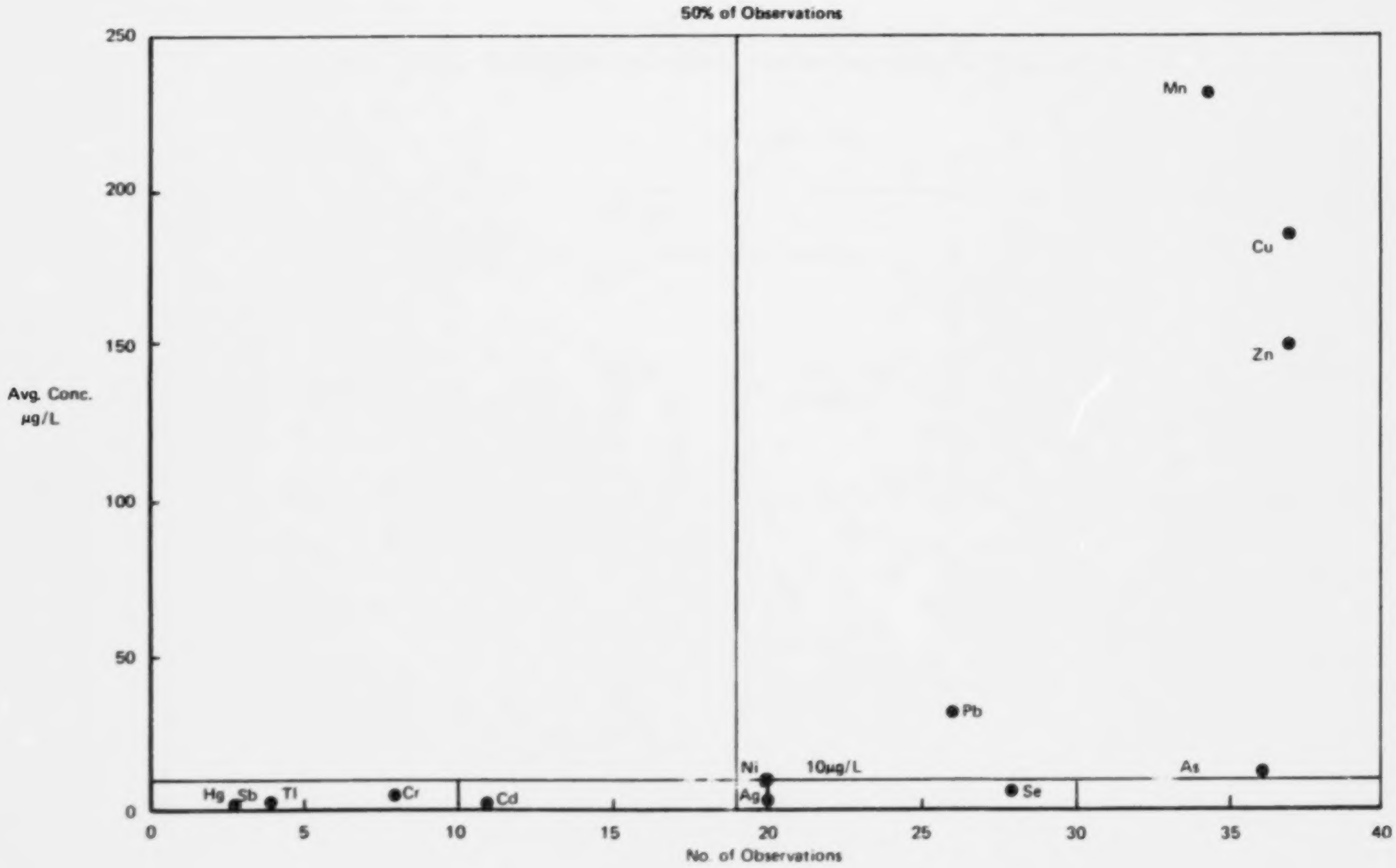

FIGURE VIII–2 (Continued) FREQUENCY OF OBSERVATIONS AND AVERAGE CONCENTRATIONS OF PRIORITY POLLUTANTS certain pollutants. Table VIII-5 gives an overall summary of the observed chemicals with respect to source type. The trihalomethanes (chloroform, dibromochloromethane, and bromodichloromethane) were detected at significant levels in the tap water, but were reduced by a factor of ten in the sewers, often dropping to levels below the detection limit. This effect is probably due to dilution and volatilization. Toluene and naphthalene were detected in commercial samples at higher concentrations than in samples from other sources. Phenol was observed in the samples taken from the Elco site classified as old residential. The levels are not excessive but phenol was consistently detected on all sampling days, suggesting a steady flow from many small sources.

In general, the number of organics observed seems to be higher for commercial and industrial sources than for residential sources. The most frequently observed organic chemicals, and those in the highest concentration, were chloroform (40 μg/L in tap water) and the phthalates (di-n-butyl phthalate was detected at 44 μg/L at the hospital). The phthalate values are believed to be reliable based upon a review of the quality control program.

Except for thallium and mercury, the detected metals were seen in almost all of the sources examined. The major source of copper contamination is non-industrial, with high levels measured at the residential sites and a concentration of 735 μg/L detected at the hospital. Commercial and industrial sources show higher levels of manganese than the residential sources.

In order to further examine the data, the average values (Table VIII-3) for all of the sources were further averaged and compared

TABLE VIII-5

CINCINNATI AVERAGE CONCENTRATIONS BY SOURCE TYPE (µg/L*)

	New Residential	Old Residential	Commercial	Industrial	All Sources	Tap Water	Influent	St. George Hospital
Trans-1,2-Dichloroethylene	-	-	-	-	-	-	-	-
Chloroform	2	3	5	2	4	40	3	12
1,1,1-Trichloroethane	-	-	3	-	1	-	-	-
Carbon Tetrachloride	-	-	-	-	-	-	-	-
Bromodichloromethane	-	-	2	-	1	17	-	10
Trichloroethylene	-	-	-	-	-	-	-	-
Benzene	-	-	7	-	3	-	4	1
Dibromochloromethane	-	-	1	-	1	15	-	7
1,1,2,2-Tetrachloroethylene	1	2	5	3	3	-	1	1
Toluene	1	5	17	2	10	-	2	-
Ethyl Benzene	-	1	9	-	5	-	1	-
Phenol	2	21	5	-	7	-	-	-
Dichlorobenzenes	-	-	1	8	1	-	-	-
Naphthalene	-	2	10	-	5	-	4	-
Diethyl Phthalate	19	26	15	8	18	3	12	5
Di-n-Butyl Phthalate	19	13	28	11	21	14	13	43
Butyl Benzyl Phthalate	7	3	4	3	3	-	-	-
Bis(2-Ethylhexyl)Phthalate	7	15	19	6	14	17	4	29
Antimony	-	3	1	1	1	-	-	-
Arsenic	21	17	9	14	14	6	23	4
Cadmium	-	1	2	1	1	2	3	-
Chromium	7	17	-	-	5	10	158	-
Copper	144	112	48	38	80	28	67	735
Lead	5	57	19	8	24	-	20	95
Manganese	81	193	390	367	282	8	347	28
Mercury	-	.1	.2	.3	.1	-	-	-
Nickel	-	11	20	12	13	13	42	-
Selenium	4	6	3	11	5	4	5	11
Silver	1	-	1	3	1	1	4	15
Thallium	-	.1	.4	.2	.2	-	-	-
Zinc	131	144	141	156	141	44	392	194
Total Cyanides	-	-	-	-	-	-	41	-
Total Phenols	28	58	37	26	39	8	25	54
Ammonia	24	20	15	11	17	-	14	3
Oil and Grease	51	85	256	22	150	3	53	18
TSS	156	514	130	87	219	3	103	110
TOC	92	102	76	70	84	4	41	536
COD	283	333	244	184	265	5	155	1390
BOD	121	157	100	69	114	3	48	645
Number of sites	1	1	2	1	5	-	-	1
Number of samples	5	6	12	3	26	4	6	2

* Classicals in mg/L

to the data for the POTW influent and tap water. The calculated values are listed in Table VIII-6. Within a factor of two, the data from the sources represent most of the findings in the POTW influent. Some examples of chemicals whose concentrations at the POTW were considerably higher than could be accounted for by the sources sampled are chromium, zinc, total cyanides and pentachlorophenol. The pentachlorophenol was only detected once at the POTW influent. A more valid comparison of the pollutant levels at the sources and at the POTW influent will be possible when reliable flow information is obtained and mass flows can be calculated.

When compared with a previous study of the Muddy Creek area(9), most of the data from the present survey agree very well. The last two columns of Table VIII-6 give the range of concentrations obtained for some of the priority pollutants under discussion. There is some discrepancy in the measured concentrations of the volatile compounds due to the fact that the two surveys followed different analytical procedures.

TABLE VIII-6

COMPARISON ACROSS MUDDY CREEK TREATMENT AREA (μg/L)
ORGANICS

	TOTAL SOURCES AVERAGE CONC.		POTW INF.		TAP WATER		INFLUENT (a)	EFFLUENT (a)
Methylene chloride							.2-70	1-10
1,1-Dichloroethylene	-		-		-			
Chloroform	5		3		40		.7-9	.1-.7
1,2-Dichloroethane	0.1		0.5		-		.4	-
1,1,1-Trichloroethane	1		0.3		-		.3-.4	-
Bromodichloromethane	2		-		17		.1-1	.1-.3
Dibromochloromethane	2		-		15		.1-.3	.1
Chlorobenzene	0.2		-		-			
Benzene	1		4		-		.3-2	.3-3.8
Ethyl Benzene	2		1		0.2			
Bromoform	0.3		-		1		.1-3.6	-
1,1,2,2-Tetrachloroethylene	3		1		-		.2-9	.3-3
1,1,2,2-Tetrachloroethane	0.1		1		-			
Toluene	6		2		-		1.5	1
Trans-1,2 dichloroethylene	-		-		-			
Phenol	5		-		-			
2,4 Dimethylphenol	0.1		-		-			
Pentachlorophenol	1		4		-			
Naphthalene	1.0		4		-			
Diethyl phthalate	15		12		2			
Di-n-butyl phthalate	24		12		14			
Bis(2-ethylhexyl)phthalate	15		4		16			
Butyl benzyl phthalate	3		-		-			
Anthracene/Phenanthrene	-		-		-			
Dichlorobenzenes	1.3		-		-			
Heptachlor	0.1		0.5		-			

TABLE VIII-6 (cont'd.)

COMPARISON ACROSS MUDDY CREEK TREATMENT AREA (μg/L)
METALS, TOTAL CYANIDES AND TOTAL PHENOLS

	TOTAL SOURCES AVERAGE CONC.		POTW INF.		TAP WATER		INFLUENT (a)	EFFLUENT (a)
Silver	3.7		4		1			
Arsenic	12		23		6		<1.5	<1.5
Beryllium	-		-		-			
Cadmium	1		2		2		.8-150	.3-130
Chromium	4		158		10			
Copper	186		66		28			
Mercury	0.1		-		-		.5-3.3	.5-2
Manganese	231		347		7			
Nickel	10		42		13			
Lead	31		20		-			
Antimony	1		-		-			
Selenium	6		5		4			
Thallium	0.2		-		-			
Zinc	150		392		44			

Total Cyanides	-		41		-			

Total Phenols	43		25		8			

TABLE VIII-6 (cont'd)

COMPARISON ACROSS MUDDY CREEK TREATMENT AREA
CLASSICAL WASTEWATER PARAMETERS (mg/L)

	TOTAL SOURCES AVERAGE CONC.		POTW INF.		TAP WATER		INFLUENT (a)	EFFLUENT (a)
pH	7.6		6.9		7.2			
T (^{o}C)	24.8		22.6		24.4			
Ammonia	16		14		0.1			
Oil and Grease	160		63		—			
TSS	170		103		1		39-228	1.7-100
TOC	160		49		4		16-120	5-34
COD	450		186		—		44-478	13-178
BOD	200		48		—			

(a) Measured range from previous Muddy Creek study (9). Approximate detection limit given where no measurable concentration. A dash (-) signifies the compound was analyzed for but not detected; a blank indicates no data available.

IX. STATISTICAL EVALUATION PROCEDURES

The development of statistical evaluation procedures has been initiated in order to be able to analyze the data to be collected from all of the source districts which will eventually be studied. The procedures are not yet fully developed, but are described briefly in this section. The suitability of the approach will be evaluated to the extent that it is possible to test with the source data. The approach is shown schematically in Figure IX-1.

For each chemical, a sequential procedure indicates the existence of significant factors which affect the concentration of the chemical. In particular, samples can be differentiated by factors such as date, time, location of sample and source type. Each factor has several treatments which depend on the number of days sampled, the sampling time period, and the number of locations. The effect of each factor cn pollutant concentrations is tested with several parallel tests listed in Table IX-1 and the outcome of these tests determines the procedure for subsequent tests of other factors. In general, the identification of a factor which affects pollutant concentrations (e.g., date of sample) indicates that subsequent analysis of variance tests for other factors should "block out" the variation due to the significant factor by use of a two-way analysis. Factors which are identified as not significantly affecting chemical concentrations are used as sample replicates to increase the power of subsequent tests.

A brief description of each of the analysis techniques is given below.

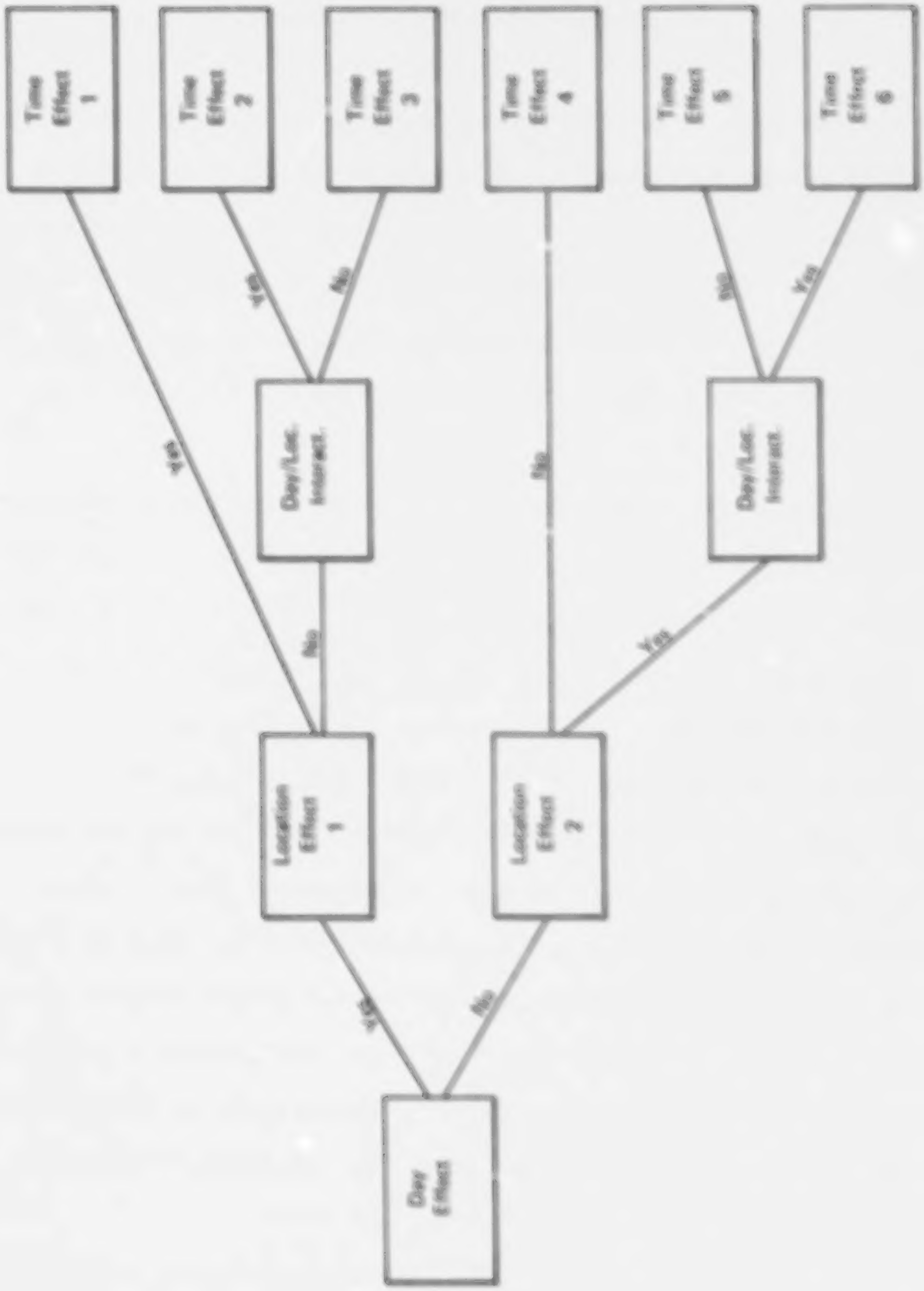
Day Effect
Yes
No
Location Effect 1
Location Effect 2
Yes
No
No
Yes
Day/Loc. Interact.
Day/Loc. Interact.
Yes
No
No
Yes
Time Effect 1
Time Effect 2
Time Effect 3
Time Effect 4
Time Effect 5
Time Effect 6

FIGURE IX-1 FACTOR EFFECT ANALYSIS APPROACH

TABLE IX-1

TESTS FOR INDICATED FACTORS

Day Effect

- (LOC x DAY) analysis of variance (ANOVA) for each chemical and chemical group
- (LOC x DAY) ANOVA based on log (conc. + 1)
- (DAY) distribution free ANOVA*
- presence/absence vs. DAYS contingency table for all chemicals aggregated

Location Effect (1)

- (LOC x DAY) ANOVA for each chemical (see DAY effect)
- (LOC x DAY) ANOVA based on log (conc. + 1) (see DAY effect)
- presence/absence vs. LOC contingency table

Location Effect (2)

- group data from (DAY x LOC) ANOVA
- LOC distribution free ANOVA*
- presence/absence vs. LOC contingency table

DAY-LOC interaction

- use ANOVA results from (DAY x LOC) ANOVA based on concentrations and log (conc. + 1)

Time Effect (1)

- (LOC x DAY x TIME) ANOVA for 2 days only
- presence/absence vs. time contingency table (same for all time effect tests)

Time Effect (2)

- same as time (1)

Time effect (3)

- (TIME x DAY) ANOVA with interaction sum of squares pooled into error sum of squares

Time Effect (4)

- (TIME) 1 way ANOVA
- (TIME) distribution free ANOVA*

Time Effect (5)

- (TIME x LOC) ANOVA with no interaction sum of squares

Time Effect (6)

- (TIME x LOC) ANOVA

***Kruskal-Wallis Test**

Analysis of Variance

One way:

This procedure analyzes the model:

$$\text{concentration}_{ij} = \mu + \sum_i \beta_i + \varepsilon_{ij} \text{ for each chemical separately}$$

where μ = grand mean of samples

β_i= effect which treatment i has on the sample

ε_{ij}= normal and independent distributed variate with mean 0 and homogeneous variance σ^2, NID (o, σ^2). Analysis of variance statistics test the hypothesis $\beta i = 0$

Two way:

The two-way analysis of variance analyzes data which is differentiated by two factors (e.g., location and day of sample),

$$\text{concentration}_{ijk} = \mu + \sum_i \beta_i + \sum_j \gamma_j + \sum_{ij} \rho_{ij} + \varepsilon_{ijk} \text{ for each chemical separately}$$

where μ = grand mean of samples

β_i= effect of treatment i (first factor)

γ_j= effect of treatment j (second factor)

ρ_{ij}= interaction effect of the first and second factors, treatment i with j

ε_{ijk}= NID (o ,σ^2)

Separate statistics test the hypothesis $\beta_i = 0$, $\gamma_j = 0$, $\rho_{ij} = 0$

Kruskal-Wallis

This is a test for differences of the location of the median in data grouped by a single factor. It is analogous to one-way analysis of variance, but does not require that data replicates be normally distributed.

Contingency Tables

This procedure tests the hypothesis that the presence or absence of pollutants is independent of a single factor in the sample, such as sample location or date. The test is performed on all chemicals aggregated together, and thus is a measure of the effect of sampling factors on pollutants as a whole rather than on separate chemicals.

Transformations of the Data

Analysis of variance presumes that data is normally distributed with equal variance for all samples. Pollutant concentrations may be log-normally distributed. However, separate tests are performed on concentrations as well as the log of concentrations. For contingency table tests, absolute concentrations are not used but only the absence or presence of the chemicals is studied with respect to sample factors.

X. CONCLUSIONS

Completion of this study of the Muddy Creek Drainage basin has demonstrated several factors important to the study of future cities, while revealing specific information on certain priority pollutants.

It was possible to segregate various source type wastewater activities (residential, commercial, industrial) within the drainage basin. However, the surface structure zoning and subsurface connections to the wastewater collection system are largely independent activities and great care must be taken to insure the maximum isolation of a given source type. Part of the success in source isolation is attributed to being able to use alternate sites, a possibility which is inherently associated with larger drainage basins. It is recommended that future studies be done at sites with a minimum treatment plant capacity of at least 15 mgd.

A small number of priority pollutants were found in the sources studied. Most of the organic species and many of the metals were at low levels, close to the reporting limits. Of a possible 114 organic pollutants sought, only 24 were observed in at least one of the samples. Thirteen (13) of the 14 metals analyzed were observed - beryllium was the only metal not observed. The only confirmed pesticide observation was for heptachlor in three samples at 1-3 μg/L. No pesticides were observed in any of the other samples.

The quality control program implemented for this study was of significant value to the program. The results of the analyses of the quality control samples demonstrate that the overall recovery of organic pollutants is high (70-80%) and of sufficient precision (20-30%) to meet

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the program's needs. The metals were spiked at levels too low to establish their recovery values, because of the high sample concentrations, but the precision of the metals analyses was also found to be 20-30%. A modified set of spiking levels will be used for the next study. The quality control program has enabled the establishment of confidence limits for the values reported and should be maintained as an integral part of the study.

The determination of accurate flow values was a problem in this study and improved procedures should be sought for future studies. Future sites should be selected that have adequate documentation of water usage, and flow when possible, to supplement the actual field measurements.

The manual sampling procedures used in the study proved reliable in terms of providing accurate samples free of contamination and were readily implemented in the field.

The analytical procedures used for the chemical analyses were based on the standardized EPA protocol for priority pollutants. For most compounds those procedures worked well. For a few compounds, such as the light volatiles, benzidine and some others, the protocol still has some systematic problems. Continuing efforts should be made to provide procedures which will be reliable for all of the analytes.

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APPENDIX A

Details of Literature Search

Appendix A contains summaries of concentration data from the literature review which are relevant to the present study. The complete literature review, including the references from which these data were extracted, is published separately as part I of this study on sources of priority pollutants in POTW influents.

TABLE A-1

METALS DISTRIBUTION IN NYC METROPOLITAN AREA POTW INFLUENTS COMPARED TO U.S. URBAN POTW INFLUENTS

	Concentrations ≥ given % of data (in mg/L)		
POLLUTANT	50-U.S./50-NYC	95-US/95-NYC	100-US/100-NYC
26 Cadmium	0.015/0.02	0.06/0.04	0.240/1.1
27 Chromium	0.29/0.05	1.21/0.45	3.8/5.8
28 Copper	0.17/0.1	1.6/0.85	3.83/9.6
30 Lead	0.175/0.2	1.9/0.0045	2.96/12.2
31 Mercury	0.0013/0.0001	0.016/0.0045	0.02/0.4
32 Nickel	0.13/0.1	1.23/0.5	2.10/2.0
36 Zinc	0.68/0.18	2.2/1.14	2.7/18

TABLE A-2

DOMESTIC CONTRIBUTIONS OF METALS TO WASTEWATERS

	Concentration/% attributed to Domestic Sources (in mg/L)		
PRIORITY POLLUTANT	PITTSBURGH	MUNCIE	NEW YORK CITY
26 Cadmium	0.013/62.0	0.007/71.0	0.003/18.0
27 Chromium	0.022/2.3	0.008/2.9	0.046/38.3
28 Copper	0.12/16.5	0.12/48	0.202/84.8
30 Lead	0.075/63	0.12/13	-
32 Nickel	0.014/17.9	0.024/20	0.05/55.5
36 Zinc	0.20/30.8	0.25/31.6	0.124/31.8

TABLE A-3

URBAN RUNOFF CONTRIBUTIONS OF METALS TO WASTEWATER

PRIORITY POLLUTANT		Median FROM TABLE 1	Concentrations in mg/L U.S. (30)	TEXAS (35)	NEW YORK (41)
26	Cadmium	0.015	0.00075	0.029	0.25
27	Chromium	0.24	2.8	0.039	0.16
28	Copper	0.17	-	0.036	0.46
30	Lead	0.175	0.03	0.019	-
31	Mercury	0.0013	-	0.333	-
32	Nickel	0.13	0.01	0.02	1.6
36	Zinc	0.68	0.2	0.54	1.6

TABLE A-4

ORGANICS MEASURED IN WASTEWATER INFLUENTS

PRIORITY POLLUTANT	VALUES REPORTED (in μg/L)*
Acrolein	(20-80); (50-150)
Aldrin	(max) 0.1
γ- BHC (Lindane)	(max) 14
Chlordane	2600; 73, 2, 3
	(max) 1.5 ; 11
DDD	(4-11)
DDE	(5-16)
DDT	(0.7-3.0)
Dieldrin	(max) 2.0
Endrin	<1.0; 1.0
Toxaphene	<1.0; 1.0
Arochlor 1016	1.0; 0.1; 0.1; 0.1; 0.2; 0.25
Arochlor 1248	0.1; 0.1; 0.1; 0.1; 0.1; 0.1
Arochlor 1254	0.1; 0.1; 0.1; 0.1; 0.1; 0.1
Arochlor 1260	0.1; 0.1; 0.1; 0.1; 0.1; 0.1
PCB's	1 ; (1.0-2.0)
Dichloromethane	(25 - 750)
	(0.2-70); (10-430)
Chlorodibromomethane	(0.1-0.3); (1.9-14)
Dichlorobromomethane	(0.1-1.0); (0.4-6.1)
Tribromomethane	(0.1-3.6); (0.4-1.9)
Chloroform	(11 - 80)
	180
	2 (0.7 - 9.0); 13 (3.5 - 150)
	870 (360 - 2600)
Carbon Tetrachloride	0; 3.0
1,1-Dichloroethane	22
1,2-Dichloroethane	(42 - 26,000)

TABLE A-4 (cont'd)

ORGANICS MEASURED IN WASTEWATER INFLUENTS

PRIORITY POLLUTANT	VALUES REPORTED (in μg/L)*
1,1,1-Trichloroethane	2.0
	38, 0, 0
	(0.3-0.4); (8-790)
1,1,2,2-Tetrachloroethane	(51-500)
Vinyl Chloride	<1; (0.9-2.0)
Trichloroethene	(17 - 140)
Benzene	5.0
	(0.3-2.0); (0.5-9.8)
	27 (6 - 53)
Chlorobenzene	(20-30)
Dichlorobenzenes	(6 - 61)
	(12-47)
Ethyl Benzene	17.0
	(4 - 450)
	(27-55); (4-31)
	15; 52, 26, 5
Toluene	250
	(3 - 1700)
	(23 - 30); (12 - 36)
	60; 870, 900, 910
	(1 - 5); (8 - 150)

---

* Unless otherwise indicated, these values are means. When a range was reported, it has been given within parentheses. Data for several POTWs obtained from the same reference have been separated by semi-colons; data separated by commas are multiple values for the same POTW.

TABLE A-5

PRIMARY PROCESSES EFFLUENT CONCENTRATIONS AND $\bar{R}$

Pollutant	Effluent Concentration Range (μg/L)	Average R	ν *	Maximum Observed R	Minimum Observed R+
23 Arsenic	1-9	35	1.14	58	12
26 Cadmium	8-240	37	0.44	58	0
27 Chromium	10-3200	38	0.63	92	0
28 Copper	18-1500	48	0.59	91	0
30 Lead	20-180	56	0.29	66	0
31 Mercury	0.2-22	49	0.4	63	0
32 Nickel	60-1800	18	1.06	65	0
34 Silver	1.8-20	64	0.1	71	0
36 Zinc	55-1800	44	0.45	88	19

* coefficient of variation

+ does not include "metals addition" scenarios

TABLE A-6

SECONDARY PROCESSES AND EFFLUENT CONCENTRATIONS AND $\bar{R}$

Pollutant	Effluent Concentration Range (µg/L)	Average R (%)	ν*	Maximum Observed R	Minimum Observed R+
23 Arsenic	1-17	54	.24	85	43
26 Cadmium	1-40	50	0.4	83	0
27 Chromium	10-2500	83	0.31	92	23
28 Copper	20-1400	63	0.32	99	0
30 Lead	20-270	62	0.41	80	18
31 Mercury	0.2-4	66	0.46	69	0
32 Nickel	50-1800	29	0.65	65	0
34 Silver	10	58	0.2	73	47
36 Zinc	70-1300	63	0.26	91	30

* coefficient of variation

+ does not include "metals addition" scenarios

APPENDIX B

Detailed Sampling Plans

This appendix gives the details of the sampling plans for the two trips to the Muddy Creek district in Cincinnati, as provided to the field team.

A. First Trip

General

Beginning August 6th (Sunday) a sampling crew of 12 people will go to Cincinnati, Ohio (specifically the Muddy Creek Sewerage District) for the purpose of collecting three days' worth of wastewater samples which will be analyzed for 131 priority pollutants, plus several classical water quality parameters. The people doing the sampling will all be employees of Arthur D. Little, Inc., and will be under the direct supervision of Jeffrey W. Adams. The people will be split into four (4) sample collection teams, each of which will consist of two people, and two logistical support teams, each consisting of either one or two people. Each member of the field crew will be expected to work a minimum of twelve (12) hours per shift during the day of sample collection. Two (2) sampling teams will be scheduled to work between the hours of 5:30 AM and 6:00 PM, and two (2) will be scheduled to work from 5:30 PM to 6:00 AM. One of the logistics crew will begin at 8:00 AM and work until 8:30 PM, while the other will begin at 8:00 PM and continue until 8:30 AM. The locations to be sampled by the teams are given in Table B-1.

Because of several constraints, it has been decided that two sampling trips will be made to the Muddy Creek Sewerage District. During the first trip, 28 samples and 2 field blanks will be collected, while during the second trip, somewhere around 36 total samples will be collected. The second trip is tentatively set for mid September and will be scheduled over a week-end period.

Of the 28 wastewater samples collected during this trip, approximately 9 will be of sufficient volume to complete the QC/QA analytical requirements. The remaining 19 samples will only contain enough volume to be analyzed for specific levels of each of the priority pollutants.

Arrival

Those people working the night crew, plus myself (Jeff Adams) and Warren Lyman, will arrive in Cincinnati as late as possible Sunday evening, July 30th. Our responsibility is to pick up cars at the airport and meet those ADL employees who are driving the truck (Stan Locke plus one) to the Holiday Inn. On Monday, all will go to the POTW and begin handling the logistic requirements. Sometime during the day, Warren or I will go to each sampling location with one member of each team so that he or she can become familiar with the area and important landmarks. We also will have to pick up two vans or trucks that are to be used by the working field crews. Furthermore, someone will have to take the second driver back to the airport for transport to Boston, and hopefully transport the other field crew members to the Holiday Inn for check-in. Day team members will fly in Monday during the day and be expected on site by 2:00 PM to assist in logistics.

Departure

The departure of people from Cincinnati goes in the reverse order of their arrival, i.e., night crews leave first, while the day crew assumes responsibility for clean-up, etc.

Definition of a Composite Sample

Each composite sample consists of the following fractions:

	QC	un-QC
• An Acid/Base Neutral fraction	(6L)	(2L)
• A PCB/Pesticide fraction	(3L)	(1L)
• A Total Phenol fraction	(3L)	(1L)
• A Cyanide fraction	(3L)	(1L)
• A Metal fraction	(3L)	(1L)
• A Mercury fraction	(3L)	(1L)
• An Asbestos fraction	(3L)	(1L)
• A Volatile fraction	(<1L)	(<1L)
• A Suspended solid and BOD fraction	(2L)	(2L)
• An Oil and Grease fraction	(1L)	(1L)
• An Ammonia and Total Organic Carbon Fraction	(2L)	(2L)

Procedures

These samples will be collected at each of the identified sampling locations for these compositing periods listed within Table B-1 While we are in the process of collecting each of these samples, we must collect sufficient incremental aliquots that will allow us to flow proportion over the range of a 3:1 change in flow. In order to accommodate this requirement, we must collect a larger total volume in the field (more than the 28 L listed) and return these to Cambridge where they will be composited.

Because this field effort is envisioned to be intensive and exhausting, the number of bottles of each size that will be collected each time a site is visited has been predetermined and is given in Table B-2. Unless I personally specify changes, this list is to be followed verbatim.

In addition to defining the sample bottles that are to be collected, I have written a tentative schedule of activities to be adhered to during this trip. Since this is our first trip and we really cannot predict what is going to happen, we currently plan to visit each manhole or sampling point no more frequently than once every three hours. Specific recommendations of site locations are presented in Tables B-4 and B-5.

Sampling Sites and Methodology

There are a total of five sampling locations that must be covered routinely during each of the 24-hour collection periods. By name, these are:

1. Elco
2. Kirkridge
3. West Bourne
4. Delfair
5. POTW influent

At these five locations we will be collecting a total of six samples at a time, as two samples will be collected at the POTW. Throughout the day nine composite samples will be collected over different compositing periods by manual sampling procedures and one or two will be collected with automatic devices. To explain what samples will be collected refer to Table B-1.

During each shift, one team will work the first three sites, while the other team will work at the last two sites. This combination is selected for several reasons:

1) Both teams have one site near or at the POTW (our logistics headquarters).

2) The number of samples collected at any given time is the same (i.e., three).

3) The total number of composite samples collected during a 24-hour day is approximately equal (6 vs 5)

There are some disadvantages to this plan, those being that one team has three sites with manhole covers along with a larger amount of travel time. However, this selection appears to be the best choice for our first sampling effort.

As previously mentioned, 9 composite samples will be collected by manual methods, while 1 or 2 will be collected using automatic samplers on each day. The responsibility of each crew is to fill the proper number of sample bottles at each site, log them into a field log, label them, and transport them safely to the POTW. Actual compositing of individual sample collections to form a "composite sample" will be done back at ADL. In addition, the two teams will be required to monitor both of the automatic devices and insure that they do, in fact, collect a sample properly. This monitoring includes making sure that the compositing bottles do not overflow, the batteries do not completely run down, and that the ice supply is not exhausted.

TABLE B-1

Sampling Locations and Samples

			Method	Sample(s)	No. of Composite Samples
Teams 1 and 3	1.	Elco	Manual	One (1) 6-hour composite and one (1) 18-hour composite	2
	2.	Kirkridge	Manual	One (1) 24-hour composite (manually)	1
	3.	West Bourne	Manual	Two (2) 12-hour composites	2
Teams 2 and 4	4	Delfair	Manual	Two (2) 12-hour composites One (1) 24-hour composite (automatically), optional	3
	5.	POTW	Manual	One (1) 24-hour composite (tap water)	1
		POTW	Manual/ Automatic	One (1) 24-hour composite (manual) and One (1) 24-hour composite (automatic) at the influent.	2

TABLE B-2

Plan A1 - Each time sampling is performed at a location where a 24-hour composite (comprised of 8 increments) is collected. The following number and size of bottles will be filled for each of the identified sample fractions.

			Code
For Acid/Base Neutral fraction	Collect	2 x 1L	ABN
For Total Phenol fraction*	Collect	1 x 1L	Phenol
For PCB/Pesticide fraction	Collect	1 x 1L	PCB
For Metal fraction*	Collect	1 x 1L	M+
For Cyanide fraction*	Collect	1 x 1L	CN
For Asbestos fraction	Collect	1 x 1L	As
For Mercury fraction*	Collect	1 x 1L	Hg
For Volatile fraction*	Collect	2 x 45 mLs completely, no air space	VOA
For Total Suspended Solid and BOD fraction	Collect	1 x 1L	Class, BOD/TSS
For Total Organic Carbon* and Ammonia fraction	Collect	1 x 1L	NH_3
For Oil and Grease fraction*	Collect	1x 250 mL	Class, O+G

*Refer to Sample Preservation sheet, Table B-3.

TABLE B-2 (continued)

Plan A2 - Each time sampling is performed at a location where a 12-hour composite (comprised of 4 increments) is collected, the following number and size of bottles will be filled for each of the identified sample fractions.

			Code
For Acid/Base Neutral fraction	Collect	1 x 1L	ABN
For Total Phenol fraction*	Collect	1 x 1L	Phenol
For PCB/Pesticide fraction	Collect	1 x 1L	PCB
For Metal fraction*	Collect	1 x 1L	M+
For Cyanide fraction *	Collect	1 x 1L	CN
For Asbestos fraction	Collect	1 x 1L	As
For Mercury fraction*	Collect	1 x 1L	Hg
For Volatile fraction*	Collect	2 x 45 mLs completely, no head space	VOA
For Total Suspended Solid and BOD fraction	Collect	1 x 1L	Class,BOD/TSS
For Total Organic Carbon and* Ammonia fraction	Collect	1 x 1L	NH_3
For Oil and Grease fraction*	Collect	1 x 250 mL	Class, O+G

*Refer to Sample Preservation Sheet, Table B-3.

TABLE B-2 (continued)

Plan A3 - Each time sampling is performed at a location where a 18-hour composite (comprised of 6 increments) is collected, the following number and size of bottles will be filled for each of the identified sample fractions.

			Code
For Acid/Base Neutral fraction	Collect	1 x 1L	ABN
For Total Phenol fraction*	Collect	1 x 1L	Phenol
For PCB/Pesticide fraction	Collect	1 x 1L	PCB
For Metal fraction*	Collect	1 x 1L	M+
For Cyanide fraction*	Collect	1 x 1L	CN
For Asbestos fraction	Collect	1 x 1L	As
For Mercury fraction*	Collect	1 x 1L	Hg
For Volatile fraction*	Collect	2 x 45 mLs completely, no head space	VOA
For Total Suspended Solid and BOD fraction	Collect	1 x 1L	Class,BOD/TSS
For Total Organic Carbon and* Ammonia fraction	Collect	1 x 1L	NH_3
For Oil and Grease fraction*	Collect	1 x 250 mL	Class,O+G

---

*Refer to Sample Preservation Sheet, Table B-3.

TABLE B-2 (continued)

Plan A4 - Each time sampling is performed at a location where a 6-hour composite (comprised of 2 increments) is collected, the following number and size of bottles will be filled for each of the identified sample fractions.

			Code
For Acid/Base Neutral fraction	Collect	5 x 1L	ABN
For Total Phenol fraction*	Collect	3 x 1L	Phenol
For PCB/Pesticide fraction	Collect	3 x 1L	PCB
For Metal fraction*	Collect	3 x 1L	M+
For Cyanide fraction*	Collect	3 x 1L	CN
For Asbestos fraction	Collect	3 x 1L	As
For Mercury fraction*	Collect	3 x 1L	Hg
For Volatile fraction*	Collect	3 x 45 mLs completely, no head space	VOA
For Total Suspended Solid and BOD fraction	Collect	2 x 1L	Class,BOD/TSS
For Total Organic Carbon and* Ammonia fraction	Collect	2 x 1L	NH_3
For Oil and Grease fraction*	Collect	1 x 1L	Class, O+G

*Refer to Sample Preservation Sheet, Table B-3.

TABLE B-2 (continued)

Plan A5 - This sample collection plan will be used on Wednesday for the collection of field blanks. Each truck will be equipped with between 5 and 10 gallons of clean water that must be transferred into the appropriate bottles in the field. Teams 1 and 3 are expected to transfer these samples at the Kirkridge site and Teams 2 and 4 will transfer at the POTW.

			Code
For Acid/Base Neutral fraction	Collect	1 x 250 mL	ABN
For Total Phenol fraction*	Collect	1 x 250 mL	Phenol
For PCB/Pesticide fraction	Collect	1 x 250 mL	PCB
For Metal fraction*	Collect	1 x 250 mL	M+
For Cyanide fraction*	Collect	1 x 250 mL	CN
For Mercury fraction*	Collect	1 x 250 mL	Hg
For Asbestos fraction	Collect	1 x 250 mL	As
For Volatile fraction*	4 x 5 mL bottles, completely filled and sealed during entire day's trip		VOA

*Refer to Sample Preservation sheet, Table B-3.

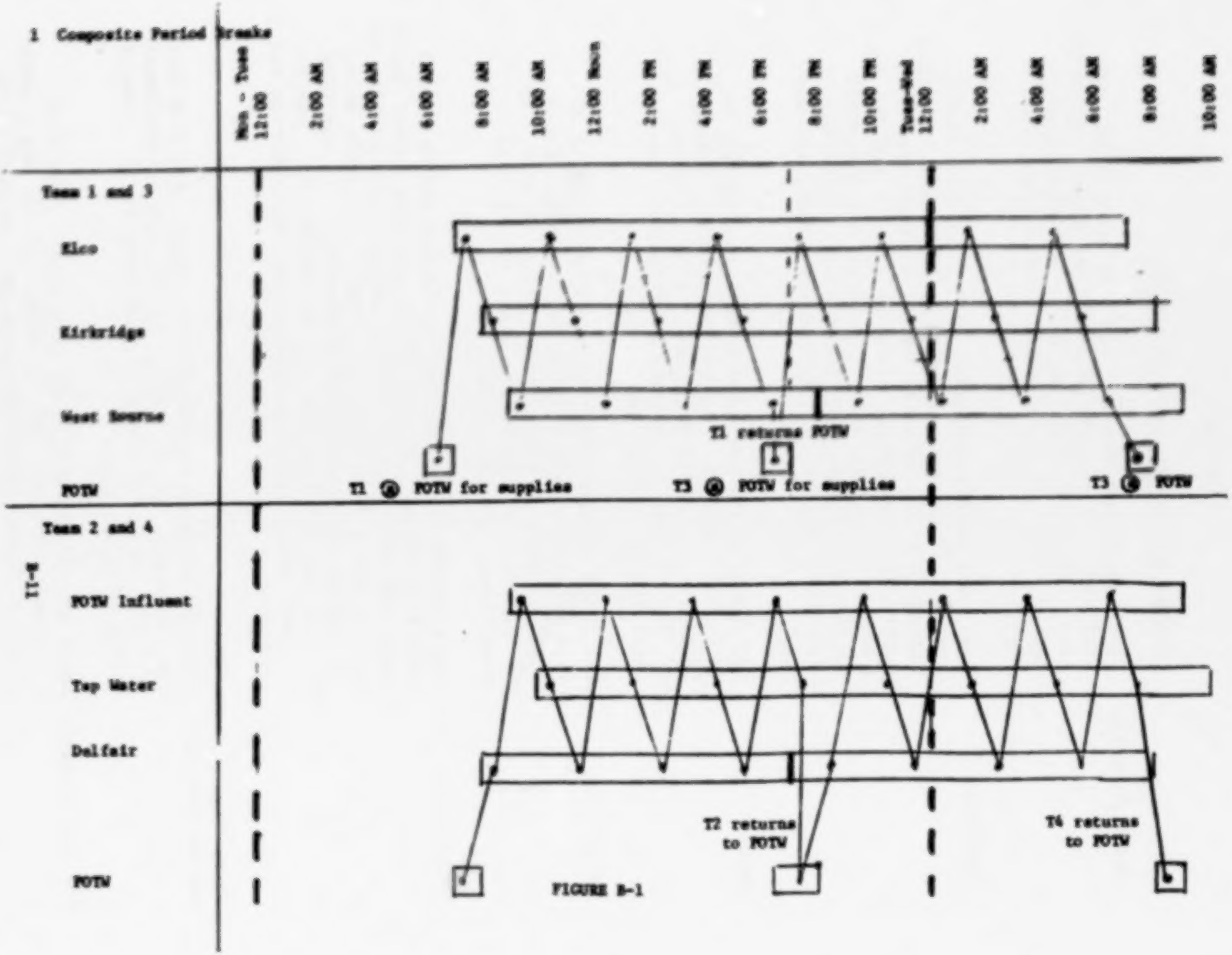
1 Composite Period Breaks
Mon - Tues 12:00
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 Noon
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Tues-Wed 12:00
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
Team 1 and 3
Elco
Kirkridge
West Bourne
POTW
T1 returns POTW
T1 @ POTW for supplies
T3 @ POTW for supplies
T3 @ POTW
Team 2 and 4
POTW Influent
Tap Water
Delfair
POTW
T2 returns to POTW
T4 returns to POTW

FIGURE B-1

TABLE B-3

Sample Preservation Requirements

Total Phenols:	Check pH of raw sample. Add 1 mL conc H_2SO_4, mix well and then recheck pH with test paper. If pH <4, stop. If pH >4, add 1 mL H_2SO_4 and recheck pH. Record amount of H_2SO_4 added. Add 1 gm/L $CuSO_4 \cdot 5H_2O$.
Cyanides:	Test each bottle collected with potassium iodide starch test paper. If color is blue, add one small Vitamin C pill and shake well. Recheck with test paper until test paper shows no color. Add 0.6 gm excess of ascorbic acid (one large and one small Vitamin C pill) to each liter bottle collected. Then add 2 mls of 10 N sodium hydroxide, and mix well.
Metals:	Add 5 mLs of concentrated nitric acid (HNO_3) to each liter bottle collected for metals. Check final pH with pH test paper. If pH <2, stop. If pH >2, add 1 mL increments until pH <2. Record total amount of HNO_3 added.
Mercury:	Add 5 mLs of concentrated nitric acid (HNO_3) to each liter bottle collected for mercury. Check final pH with pH test paper. If pH <2, stop. If pH >2, add 1 mL increments until <2. Record total amount of HNO_3 added.
Volatiles:	Check sample collected with potassium iodide starch indicator paper. If test shows positive (paper turns blue) add two drops of sodium thiosulfate solution to each of two bottle samples. Seal each bottle so no air bubble shows when bottle inverted. In addition, collect two bottles that are not preserved. Record on label which bottle preserved and which bottle not preserved.
Total Organic Carbon Ammonia:	Check pH of sample with pH test paper. Add 1 mL H_2SO_4 and check pH. If <2, stop. If >2, add 1 additional mL H_2SO_4, mix, and check pH. pH must be <2. Record volume of H_2SO_4 added.
Oil and Grease:	Check pH of sample with pH test paper. Add 1 mL H_2SO_4 and check pH. If <2, stop. If >2, add 1 additional mL H_2SO_4, mix, and check pH. pH must be <2. Record volume of H_2SO_4 added.

TABLE B-4

Teams 1 and 3 (T1 and T3)

Responsible for collecting samples from three locations:

Elco
Kirkridge
West Bourne (See Figure B-1)

- -

Specific samples to be collected:

Elco - 1-18 hour composite starting at 6:01 AM (Tues) until 12:00 PM (Tues/Wed) - Repeat 3 days - Elco #1

Elco - 1-6 hour composite starting at 12:01 AM (Wed) until 6:00 AM (Wed) - Repeat 3 days - Elco #2

Kirkridge - 1-24 hour composite starting at 6:00 AM (Tues) until 6:00 (Wed) - Repeat 3 days - Kirkridge

West Bourne - 2-12 hour composites. First begins at 8:00 AM (Tues) un
8:00 PM (Tues); 2nd beginning at 8:00 PM (Tues) until 8:
(Wed). Repeat 3 days-Del #1 & Del #2, Plus 1 field blank collected on Wednesday at Kirkridge FB #1

- -

ITINERARY

Tuesday

6:00 AM - Team 1 (T1) arrives at POTW, gathers bottles, ice chests, supplies, etc.

6:45 AM - T1 leaves POTW for Elco.

7:00 AM - T1 arrives at Elco to collect samples -
1st - measure flow and record
2nd - measure temperature, pH and record
3rd - collect samples, seal, label and ice down (see Plan A3)
4th - (optional) measure flow and time and record.

7:45 AM - T1 leaves Elco, drives to Kirkridge.

8:00 AM - Arrive at Kirkridge and collect sample by Plan A1. On Wednesday start collecting field blank according to Plan A5.

9:00 AM - T1 arrives at West Bourne. Follow procedure as listed above only collect samples by Plan A2.

TABLE B-4 (continued)

10:00 AM - T1 arrives at Elco, repeats 7:00 Am instructions, sample collection by Plan A3.

10:45 AM - T1 leaves Elco, drives to Kirkridge.

11:00 AM - T1 at Kirkridge, repeats 8:00 AM instructions, sample collection by Plan A1. (Wednesday, FB#1, Plan A5)

12:00 N - T1 at West Bourne, repeats 9:00 AM instructions, sample collection by Plan A2.

1:00 PM - Elco, Plan A3

2:00 PM - Kirkridge, Plan A1 (Wednesday, FB#1, Plan A5)

3:00 PM - West Bourne, Plan A2

4:00 PM - Elco, Plan A3

5:00 PM - Kirkridge, Plan A1 (Wednesday, FB#1, Plan A5)

6:00 PM - West Bourne, Plan A2

6:15 PM - Team 3 (T3) arrives at POTW, obtains supplies for night sampling.

7:00 PM - T1 and T3 arrive at Elco. T1 transfers samples from truck to wagon, T3 transfers supplies from wagon to truck. T1 returns to POTW and gives samples to logistical team for shipment. T3 collects sample at Elco, by Plan A3. Measures and records flow, pH, temperature.

8:00 PM - T3 at Kirkridge Plan A1 (Wednesday, FB#1, Plan A5)

9:00 PM - T3 at West Bourne Plan A2

10:00 PM - T3 at Elco Plan A3

11:00 PM - T3 at Kirkridge Plan A1 (Wednesday, FB#1, Plan A5)

12:00 M - T3 at West Bourne Plan A2

1:00 AM - T3 at Elco Plan A3

2:00 AM - T3 at Kirkridge Plan A1 (Wednesday, FB#1, Plan A5)

3:00 AM - T3 at West Bourne Plan A2

4:00 AM - T3 at Elco collects first increment of 6-hour composite sample collection by Plan A4.

TABLE B-4 (continued)

5:00 AM - T3 at Kirkridge   Plan A1 (Wednesday, FB#1, Plan A5)

6:00 AM - T3 at West Bourne Plan A2

7:00 AM   Back to POTW

At the completion of sample collection, T3 returns to POTW to hand over samples to logistic team.

Team 1 reports to POTW around 7:00 AM Wednesday morning to assist in packaging of samples for air freight.

Repeat this cycle Tuesday, Wednesday and Thursday.

TABLE B-5

Teams 2 and 4 (T2 & T4)

Responsible for collecting samples at two locations and maintaining automatic samplers.

Delfair

The POTW

- -

Specific samples to be collected:

Delfair - 2-12 hour composites, one beginning at 8:00 AM (Tues) until 8:00 PM (Tues), the second from 8:00 PM (Tues) until 8:00 AM (Wed).

POTW - 1-24 hour composite of influent water
- 1-24 hour composite of tap water

Delfair - 1-24 hour composite by automatic sampler (optional)

POTW - 1-24 hour composite of influent by automatic sampler (on Tuesday and Wednesday only) plus one field blank at POTW on Wednesday.

- -

ITINERARY

Tuesday

7:00 AM - Team 2 (T2) arrives at POTW, gathers bottles, ice chests, supplies, etc.

7:45 AM - T2 leaves POTW, drives to Delfair -- before leaving starts automatic sampler

8:00 AM - T2 at Delfair to collect samples
1st, measure flow and record;
2nd, measure temperature, pH and record;
3rd, collect samples, seal, label and ice down samples (see plan A2),
4th (optional), measure and record flow 2nd time.

Upon arrival at this site, the automatic sampler should be started.

8:45 AM - Leave Delfair, drive to POTW.

9:00 AM - Arrive at POTW and collect influent sample by Plan A1.
(Wednesday, FB#2, Plan A5)

10:00 AM - Collect tap water sample by Plan A1.

TABLE B-5 (continued)

10:45 AM - Before leaving, check automatic sampler, then drive to Delfair.

11:00 AM - Collect sample at Delfair by Plan A2--also measure and record pH, temperature and flow--check automatic sampler.

12:00 N - Return to POTW and collect sample of tap water and influent by Plan A1. (Wednesday, FB#2, Plan A5)

2:00 PM - Delfair - Plan A2.

3:00 PM - POTW - Plan A1 - influent and tap. (Wednesday, FB#2, Plan A5)

5:00 PM - Delfair - Plan A2

6:00 PM - POTW - Plan A1 - influent and tap (Wednesday, FB#2, Plan A5)

6:30 PM - Team 4 (T4) arrives at POTW to obtain supplies and pack van. As soon as team 2 completes samples they are free to return to Holiday Inn.
Team 4 stays at POTW to assist with handling of samples that have been returned.

7:45 PM - T4 leaves to drive to Delfair.

8:00 PM - T4 at Delfair--1st-measure and record flow data;
2nd - measure and record pH and temperature;
3rd - collect a manual sample by Plan A2
4th - check automatic sampler
5th - (optional) measure and record flow.

9:00 PM - T4 - Back at POTW - collect influent and tap water samples by Plan A1. (Wednesday, FB#2, Plan A5)

11:00 PM - T4 - Back at Delfair - sample collection by Plan A2.

12:00 M - To POTW - collect influent and tap water sample by Plan A1. (Wednesday, FB#2, Plan A5)

2:00 AM - T4 at Delfair - collection by Plan A2.

3:00 AM - T4 at POTW - Influent and tap water samples by Plan A1. (Wednesday, FB#2, Plan A5)

5:00 AM - T4 at Delfair - collection by Plan A3.

6:00 AM - T4 at POTW - Influent and tap water by Plan A1. (Wednesday, FB#2, Plan A5)

B. Second Trip

Beginning September 6th (Wednesday), a sampling crew of 14 people will go to Cincinnati, Ohio (specifically the Muddy Creek Sewerage District) for a second trip to collect three days' worth of wastewater. The 14 people will be split into four (4) sample collection teams, each of which will consist of two people, and two logistical support teams, each consisting of either one or two people. Each member of the field crew will be expected to work a minimum of twelve (12) hours per shift during the day of sample collection. Two (2) sampling teams will be scheduled to work between the hours of 6:30 AM to 7:00 PM, and two (2) will be scheduled to work from 6:30 PM to 7:00 AM. One of the logistics crew will begin at 8:00 AM and work until 8:30 PM, while the other will begin at 8:00 PM and continue until 8:30 AM.

Of the 34 wastewater samples collected during this trip, approximately 9 will be of sufficient volume to complete the QC/QA analytical requirements and 25 will only contain enough volume to be analyzed for specific levels of each of the priority pollutants. Six samples were also collected as manual and autosampler field blanks.

Arrival

Those people working the night crew will arrive in Cincinnati as late as possible Wednesday evening, September 6th. Our responsibility is to pick up cars at the airport and meet those ADL employees who are driving the truck (Stan Locke plus one) to the Holiday Inn. On Thursday, all will go to the POTW and begin handling the logistic requirements. Sometime during the day, Warren or I (Jeff Adams) will go to each sampling location with one member of each team so that he or she can become familiar with the area and important landmarks. We also will have to pick up two Ryder trucks that are to be used by the working field crews. Furthermore, someone will have to take the second driver back to the airport for transport to Boston, and hopefully, transport the other field crew members to the Holiday Inn for check-in. Day team members will fly in Monday during the day and be expected on site by 2:00 PM to assist in logistics.

Departure

The departure of people from Cincinnati goes in the reverse order of their arrival, i.e., night crews leave first, while the day crew assumes responsibility for clean-up, etc. Everything, hopefully, happens in the reverse order.

Sampling Sites and Responsibilities

There are a total of eight locations that must be covered routinely during the three-day sampling period. By name, these are:

1. POTW influent

2. Tap Water

3. Elco
4. Kirkridge
5. Delfair
6. West Bourne
7. Saint George
8. Sylved

By visiting these eight locations at regularly scheduled intervals, we will be collecting approximately eleven (11) samples per day for analysis. While most of the sample collection is done by manual methods, some is also accomplished by the use of automatic devices. To explain what samples will be collected during this trip refer to Table B-6.

During each shift, one team will work the first four sites, while the other team will handle the remaining four sites. This combination of sites has been arranged for several reasons:

1) Both teams have sampling sites that are in the same relative geographical locations permitting relatively short driving times between locations.
2) Each sampling team is responsible for collecting approximately the same number of samples per shift (4).
3) Each team is responsible for monitoring one of the automatic devices.

Although there are some disadvantages to the schedule that has been designed, at this time it appears that this system is the best that is available.

As previously mentioned, between 9 and 11 composite samples will be collected each day by manual methods, while an additional 1 or 2 will be collected by the automatic devices.

Procedures

These samples will be collected at each of the identified sampling locations for these compositing periods listed within Table B-6. While we are in the process of collecting each of these samples, we must collect sufficient incremental aliquots that will allow us to flow proportion over the range of a 3:1 change in flow. In order to accommodate this requirement, we must collect a larger total volume in the field (more than the 28 L listed) and return these to Cambridge where they will be composited. The sample requirements for each site are given in Table B-7.

The sample collection procedures outlined in Table B-7 are to be followed without exception.

In addition to defining the sample bottles that are to be collected, a tentative schedule of collection activities to be adhered to during this trip is presented in Table B-8. Specific scheduling of sites is given in Table B-9.

TABLE B-6

Sampling Locations and Samples

Team Responsible	Location	Method	Samples/day	Days of Collection	Total number of Composites obtained
1 + 3	POTW Influent	Manual	1-24 hour composite	Fri. Sat, Sun	3
	POTW Influent	Automatic	1-24 hour composite	Fri, Sat	2
	Tap water	Manual	1-24 hour composite	Fri, Sat	2
	Elco	Manual	1-24 hour composite	Fri, Sat, Sun	3
	Kirkridge	Manual	1-24 hour composite	Sat, Sun	2
	Field Blank	Manual	1-24 hour composite	Fri	1
2 + 4	Delfair	Manual	2-12 hour composites	Fri, Sat, Sun	6
	Delfair	Automatic	1-24 hour composite	Fri, Sat	2
	Sylved	Manual	1 or 2-12 hour Composites	Fri, Sat, Sun	3 or 6
	Saint George	Manual	1 grab or 24 hour Composite	Fri, Sat	2
	West Bourne	Manual	2-12 hour composites	Fri-Sat, Sun	6
	Field Blank	Manual	1-24 hour composite	Sun	1
					33-36

TABLE B-7

Plan A1 - For each time samples are collected at the POTW INFLUENT, or ELCO, the following number and size of bottles are to be filled.

			Code
For Acid/Base Neutral fraction	Collect	2 x 1L	ABN
For PCB/Pesticide fraction	Collect	1 x 1L	PCB
For Volatile fraction* Note: These three fractions are air-freighted to Boston Daily	Collect at least 1 x 45 mL screw cap vial--do not leave any bubbles in container (See note on Preservation Sheet)		VOA
For Total Phenol fraction*	Collect	1 x 1L	Phenol
For Cyanide fraction*	Collect	1 x 1L	CN
For Metal and Mercury fraction*	Collect	2 x 1L	M^+, Hg
For Asbestos, Total Suspended Solids and BOD fraction	Collect	2 x 1L	As, Class, BOD, TSS
For TOC, COD, NH_3 fraction*	Collect	1 x 1L	NH_3
For Oil and Grease fraction*	Collect	1 x 500 mL	Class, O + G

---

*Refer to Sample Preservation Sheet, Table B-3.

TABLE B-7 (continued)

Plan A2 - Each time a sample is collected from KIRKRIDGE or from the source of TAP WATER, the following number and size of bottles are to be filled.

			Code
For Acid/Base Neutral fraction	Collect	1 x 1L	ABN
For PCB/Pesticide fraction	Collect	1 x 1L	PCB
For Volatile fraction*	Collect at least 1 x 45 mL screw cap vial--do not leave any bubbles in vial (See note on Preservation Sheet)		VOA
Note: These three fractions are air-freighted to Boston Daily			

For Total Phenol fraction*	Collect	1 x 1L	Phenol
For Cyanide fraction*	Collect	1 x 1L	CN
For Metal and Mercury fraction*	Collect	1 x 1L	M^+, Hg
For Asbestos, Total Suspended Solids and BOD fraction	Collect	1 x 1L	As, Class, BOD, TSS
For TOC, COD, NH_3 fraction*	Collect	1 x 1L	NH_3
For Oil and Grease fraction*	Collect	1 x 500 mL	Class, O + G

---

*Refer to Sample Preservation Sheet, Table B-3.

TABLE B-7 (continued)

Plan A3 - Each time a sample is collected from either DELFAIR, SYLVED, or WEST BOURNE AT NIGHT, the following number and size of bottles are to be filled.

			Code
For Acid/Base Neutral fraction	Collect	1 x 1L	ABN
For PCB/Pesticide fraction	Collect	1 x 1L	PCB
For Volatile fraction[*]	Collect at least 2 x 45 mL screw cap vials--do not leave any air bubbles in containers (See notes on Preservation Sheet)		VOA
Note: These three fractions are air-freighted to Boston Daily			
For Total Phenol fraction[*]	Collect	1 x 1L	Phenol
For Cyanide fraction[*]	Collect	1 x 1L	CN
For Metal and Mercury fraction[*]	Collect	1 x 1L	M^+, Hg
For Asbestos, Total Suspended Solids and BOD fraction	Collect	1 x 1L	As, Class, BOD, TSS
For TOC, COD, NH_3 fraction[*]	Collect	1 x 1L	NH_3
For Oil and Grease fraction[*]	Collect	1 x 500 mL	Class, O + G

---

[*] Refer to Sample Preservation Sheet, Table B-3.

TABLE B-7 (continued)

Plan A4 - Each time a FIELD BLANK is collected, the following number and size of bottles should be filled.

			Code
For Acid/Base Neutral fraction	Collect	1 x 500 mL	ABN
For PCB/Pesticide fraction	Collect	1 x 250 mL	PCB
For Volatile fraction[*]	Collect	5 x 45 mLs-- do not leave any bubbles in the screw cap vials-- These samples only have to be collected once during the entire day and should be collected during the first increment period	VOA
Note: These three fractions are air-freighted to Boston Daily			

- -

For Total Phenol fraction[*]	Collect	1 x 250 mL	Phenol
For Cyanide fraction[*]	Collect	1 x 250 mL	CN
For Metal and Mercury fraction[*]	Collect	1 x 500 mL	M^+, Hg
For Asbestos fraction	Collect	1 x 250 mL	As

---

[*] Refer to Sample Preservation Sheet, Table B-3.

TABLE B-7 (continued)

Plan A-5 - At the end of a 24-hour collection period for each AUTOMATIC SAMPLER, the collected volume should be split into the following sample bottles.

			Code
For Acid/Base Neutral fraction	Collect	2 x 1L	ABN
For PCB/Pesticide fraction	Collect	1 x 1L	PCB
For Total Phenol fraction*	Collect	1 x 1L	Phenol
For Cyanide fraction*	Collect	1 x 1L	CN
For Metal fraction*	Collect	1 x 1L	M^+
For Mercury fraction*	Collect	1 x 1L	Hg
For Asbestos fraction	Collect	1 x 1L	As
For Total Suspended Solids and BOD fraction	Collect	1 x 1L	Class, BOD/TSS
For TOC, COD fraction*	Collect	1 x 1L	Class, TOC, COD
For Oil and Grease fraction*	Collect	1 x 1L	Class, O + G
For NH_3 fraction*	Collect	1 x 1L	NH_3

---

*Refer to Sample Preservation Sheet, Table B-3.

TABLE B-7 (continued)

Plan A6

Each time a sample is collected at SAINT GEORGE, the following number and sizes of bottles should be filled. This plan is slightly different from the others in the fact that more bottles are collected during the first visit to the site than at any other time.

	Visit 1	Visit 2 & up	Code
For Acid Base Neutral fraction	Collect 2x1L	Collect 1x1L	ABN
For PCB Pesticide fraction	Collect 2x1L	Collect 1x1L	PCB
For Volatile fraction*	Collect at least 1x45 mL screw cap vial - no head space	1x45 mLs	VOA

Note: These fractions are air freighted to Boston daily

For Total Phenol fraction*	Collect 1x1L	Collect 1x1L	Phenol
For Cyanide fraction*	Collect 1x1L	Collect 1X1L	CN
For Metal and Mercury fraction*	Collect 1x1L	Collect 1x1L	Mt,Hg
For Asbestos fraction	Collect 1x1L	Collect 1x1L	As
For Total Suspended Solids and BOD fraction	Collect 1x1L	Collect 1x1L	Class BOD/TSS
For TOC, COD, NH_3 fraction*	Collect 2x1L	Collect 1x1L	NH_3
For Oil and Grease fraction*	Collect 1x1L	Collect 1x500m	Class O+G

*See Sample Preservation Sheet, Table B-3

TABLE B-7 (continued)

Plan A7 - For each time samples are collected at WEST BOURNE DURING THE DAY (6:00 AM - 6:00 PM), the following number and size bottles are to be filled.

			Code
For Acid/Base Neutral fraction	Collect	3 x 1L	ABN
For PCB/Pesticide fraction	Collect	2 x 1L	PCB
For Volatile fraction[*] Note: These three fractions are air-freighted to Boston Daily	Collect at least 2 x 45 mL screw cap vials--do not leave any bubbles in containers (See note on Preservation Sheet)		VOA

For Total Phenol fraction[*]	Collect	2 x 1L	Phenol
For Cyanide fraction[*]	Collect	2 x 1L	CN
For Metal fraction[*]	Collect	2 x 1L	M^+
For Mercury fraction[*]	Collect	2 x 1L	Hg
For Asbestos fraction	Collect	2 x 1L	As
For Total Suspended Solids and BOD fraction	Collect	1 x 500 mL	Class, BOD/TSS
For TOC/COD/NH_3 fraction[*]	Collect	1 x 1L	NH_3
For Oil and Grease fraction[*]	Collect	1 x 500 mL	Class O + G

---

[*] Refer to Sample Preservation Sheet, Table B-3.

TABLE B-8

What to do During Manual Sample Collection

1) Gain access to the sampling locatin.

2) Set up page in field log notebook as per example. Use one page per sample location and visit. Example: since Kirkridge Acres is visited 4 times per work shift, 4 separate notebook pages should be used. In addition, 1 or 2 pages should be reserved for comments about each site per shift.

3) Fill in all preliminary data in field notebook: location, collectors (initials are sufficient), time, and date.

4) Using the telescoping pole and bucket, obtain a wastewater sample.

5) While keeping the contents of the bucket well mixed, measure and record the pH and temperature of the wastewater. Also test sample with potassium iodide test paper. (If test is positive [paper turns blue] collect and preserve 2 additional VOA bottles. (see Table B3)

6) Attach the sample labels to the appropriate number and size of bottles. Number and size information is given in plans A1 through A7.

7) Fill in all the information required on labels.

8) After labeling requirements are completed, seal the label with 2" wide scotch tape.

9) Fill all 1L bottles to the neck with sample. Preserve appropriate bottles as below. Fill VOA bottles to overflowing (except if preservative is added as per Attachment C.

10) Add preservative to each bottle that requires it (see Table B3) i.e.,

Phenols	H_2SO_4 plus 1 gm/L $CuSO_4 \cdot 5H_2O$
Cyanides	Ascorbic acid until KI paper shows no color, plus 0.6 gm excess per liter plus 2 mL/L 10N sodium hydroxide.
Metals	5 mL/L concentrated nitric acid
Mercury	5 mL/L concentrated nitric acid
Total organic carbon COD NH_3	Concentrated sulfuric acid
Oil and Grease	Concentrated sulfuric acid

Volatiles as required.

11) Cover all bottle mouths (except VOAs) with Teflon film and seal with screw caps.

TABLE B-8 (continued)

12) Cover all VOAs bottles with Teflon silicon septum (Teflon side towards sample). These bottles should not have any air bubbles in them!!!

13) Transcribe sample bottle number from label onto cap of bottle with yellow marker.

14) Transcribe sample bottle number and fraction identification code into field notebook.

15) Pack all bottles into ice chests. Segregate all Acid/Base Neutral, PCB/Pesticide and VOA fractions into one chest, i.e., all these fractions from all sites are stored in one chest. All other samples are stored in other chests as required.

16) Measure and record depth (cm) using dip rule and grease.

17) Close up manhole and move to next site.

TABLE B-9

ITINERARY (Teams I and III)

SAMPLE LOCATION	TIME OF COLLECTION (Military Units)								SAMPLING PLAN
	TEAM I IN: 0615 OUT: 1900				TEAM III IN: 1815 OUT: 0700				
					FRIDAY				
POTW-INF	0700	1000	1300	1600	1900	2200	0100	0400	A1
TAP WATER	0700	1000	1300	1600	1900	2200	0100	0400	A2
AUTO SAMPLER	0700	1000	1300	1600	1900	2200	0100	0400	A5
ELCO	0800	1100	1400	1700	2000	2300	0200	0500	A1
FIELD BLANKS	0900	1200	1500	1800	2100	2400	0300	0600	A4
					SATURDAY				
POTW-INF	0700	1000	1300	1600	1900	2200	0100	0400	A1
TAP WATER	0700	1000	1300	1600	1900	2200	0100	0400	A2
AUTO SAMPLER	0700	1000	1300	1600	1900	2200	0100	0400	A5
ELCO	0800	1100	1400	1700	2000	2300	0200	0500	A1
KIRKRIDGE	0900	1200	1500	1800	2100	2400	0300	0600	A2
					SUNDAY				
POTW-INF	0700	1000	1300	1600	1900	2200	0100	0400	A1
AUTO SAMPLER	0700	1000	1300	1600	1900	2200	0100	0400	A5
ELCO	0800	1100	1400	1700	2000	2300	0200	0500	A1
KIRKRIDGE	0900	1200	1500	1800	2100	2400	0300	0600	A2

TABLE B-9 (continued)

ITINERARY (Teams II and IV)

SAMPLE LOCATION	TIME OF COLLECTION (Military Units)								SAMPLING PLAN
	TEAM II IN: 0715 OUT: 2000				TEAM IV IN: 1915 OUT: 0800				
					FRIDAY				
DELFAIR	0800	1100	1400	1700	2000	2300	0200	0500	A3
AUTO SAMPLER	0800	1100	1400	1700	2000	2300	0200	0500	A5
SYLVED	0900	1200	1500	1800	2100	2400*	0300*	0600	A3
WEST BOURNE	1000	1300	1600	1900	2200	0100	0400	0700	A7 Days/ A3 Nights
ST. GEORGE	1000	--	1600	--	2200	--	0400*	--	A6
					SATURDAY				
DELFAIR	0800	1100	1400	1700	2000	2300	0200	0500	A3
AUTO SAMPLER	0800	1100	1400	1700	2000	2300	0200	0500	A5
SYLVED	0900	1200	1500	1800	2100	2400*	0300*	0600	A3
WEST BOURNE	1000	1300	1600	1900	2200	0100	0400	0700	A7 Days/ A3 Nights
ST. GEORGE	1000	--	1600	--	2200	--	0400*	--	A6
					SUNDAY				
FIELD BLANK	0800	1100	1400	1700	2000	2300	0200	0500	A4
DELFAIR	0800	1100	1400	1700	2000	2300	0200	0500	A3
SYLVED	0900	1200	1500	1800	2100	2400*	0300*	0600	A3
WEST BOURNE	1000	1300	1600	1900	2200	0100	0400	0700	A7 Days/ A3 Nights

* If possible

APPENDIX C

Details On Analytical Methods

This appendix gives a detailed description of the procedures used for the chemical analyses. The calibration data and examples of chromatograms are given where appropriate.

The analytical methods for each priority pollutant category are described in this section. The categories are:

- Volatiles
- Acids
- Base/Neutrals
- Pesticides and PCBs
- Total Cyanides
- Total Phenols
- Metals

The methods used in this program were as described in the "Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants", U.S. EPA, Cincinnati, Ohio.(1) The methods have been updated as recommended by EPA. The updates are indicated in the method descriptions.

Each category's method includes a brief description of the method and comments on the method. Also included, where appropriate, is a table of the priority pollutants in the category, containing analytical information; a table of calibration data for each compound; a table of the priority pollutants' reporting limits; a reconstructed gas chromatogram (RGC) or gas chromatogram (GC) of a mixture of the priority pollutants within the category; and a sample calibration curve.

VOLATILES' METHOD

A Tekmar liquid sample concentrator, model LSC 1, was used to purge a five-mL sample* aliquot with helium at 40 mL min^{-1}, for 12 minutes. The purged volatiles were then desorbed from a Tenax-GC/Davison Type 15 silica gel sorbent trap for 4 minutes at 180°C. The desorbed sample was subsequently chromatographed onto a 6-ft x 2-mm I.D. glass gas chromatographic (GC) column, packed with Carbopack C (60/80 mesh) coated with 0.2% Carbowax 1500. The GC column was programmed from 60°C (isothermal 3 minutes) to 160°C (isothermal 20 minutes) at a rate of 8°C per minute.

The gas chromatograph is interfaced with a Finnigan 4000 mass spectrometer. The mass spectrometer was interfaced with an Eclipse C200 computer system. Tuning requirements for the gas chromatography/mass spectrometer instrument were met for this method using pentafluorobromobenzene (PFBB) as recommended in the protocol.[1] Relative peak areas from the specific analytical m/e ion were calculated using bromochloromethane and 2-bromo-1-chloropropane as the internal standards.

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* Volatile samples in 45-mL vials were stored in metal cans containing activated carbon, at 4°C.

Table C-1 lists the compounds analyzed for in the volatiles' method, the relative retention times and the analytical ions (m/e and intensity) used to identify and quantify compounds in the volatile category. Table C-2 lists the reporting limits for samples collected on the first and second trips to the Cincinnati POTW. Table C-3 lists the calibration values used for concentration calculations. These values were based on a linear regression analysis performed on the daily calibration data. Values for Trip II use calibration data from both trips. Figure C-1 is a reconstructed gas chromatogram of a mixture containing all the compounds in the volatile category. Figure C-2 is the calibration curve for chlorobenzene.

Comments on the Volatiles' Method

The original protocol[1] recommended that the priority pollutant volatile compounds be reported to a minimum concentration of 10 μg/L. The method, as used in this program, reported the volatile compounds to a minimum concentration of 1 μg/L, for most of the compounds in the category (Table C-2).

The original protocol[1] also recommended that acrolein and acrylonitrile be analyzed using a direct aqueous injection technique onto a gas chromatographic column. This technique was feasible at concentration levels greater than 1 mg/L. Experiments using the purge and trap technique demonstrated that acrolein and acrylonitrile could be quantified, respectively, at 7 μg/L and 1 μg/L concentration levels, using this technique. Acrolein and acrylonitrile were subsequently added to the volatile compound category.

Problems were encountered with the more volatile compounds in this category. Chloromethane, bromomethane, vinyl chloride and dichlorodifluoromethane did not work using the EPA method, as described. Apparently these compounds break through the Tenax/Silica Gel Trap.

Data was erratic for methylene chloride, probably due to a sporadic contamination problem. This is the usual finding for most analytical laboratories.

We were unable to analyze for chloroethane in the samples from the first trip to Cincinnati; however, this compound was detectable in the samples from the second trip and the data has been included. Chloroethane also seems to break through the Tenax/Silica Gel Trap.

Bromochloromethane was used as the internal standard for the first trip to Cincinnati. Some problems with this compound due to its high volatility were indicated, therefore 2-bromo-1-chloro-butane was used for samples from the second trip to Cincinnati.

ACID METHOD

A one-liter sample aliquot was adjusted to a pH of less than 2 with 6 N HCl. The sample was sequentially extracted with 250 mL:100 mL: 100 mL of methylene chloride, and centrifuged to break emulsions, within 48 hours of sample receipt in the laboratory. The extracted sample was stored in an amber glass bottle at 4°C, while waiting for drying and concentrating.

TABLE C-1

VOLATILES COMPOUND CATEGORY

Peak #[a]	Compound	Relative Retention Times	Analytical Ions m/e (intensity)			
19	2-Bromo-1-Chloropropane, I.S.	1.00	77(100)	79(33)	156(5)	
6	Bromochloromethane, I.S.	0.44	128(70)	49(100)	130(92)	51(31)
22	1,4-Dichlorobutane, I.S.	1.26	55(100)	90(30)	92(10)	
	Chloromethane[b]	0.15	50(100)	52(32)	49(10)	
	Dichlorodifluoromethans[b]	0.17	101(13)	103(9)	85(100)	87(33)
	Bromomethane[b]	0.18	94(100)	96(94)	79(10)	81(10)
	Vinylchloride[b]	0.19	62(100)	27(64)	64(33)	26(18)
	Bis-chloromethyl ether[c]	0.76	79(100)	81(33)		
	Chloroethyl vinyl ether[c]	0.99	106(18)	63(95)	65(32)	
1	Chloroethane	0.22	64(100)	27(67)	66(33)	49(28)
2	Methylene chloride	0.30	84(86)	49(100)	86(55)	51(33)
3	Acrolein	0.32	56(72)	27(100)	26(54)	55(51)
4	Trichlorofluoromethane	0.35	101(100)	103(66)	66(12)	105(11)
4	Acrylonitrile	0.36	53(100)	26(97)	52(73)	51(30)
5	1, 1-dichloroethylene	0.39	96(80)	61(100)	98(52)	63(33)
7	1, 1-dichloroethane	0.47	63(100)	27(72)	65(33)	83(12)
8	Trans-1, 2-dichloroethylene	0.52	96(67)	61(100)	98(43)	63(33)
9	Chloroform	0.58	83(100)	85(64)	47(30)	48(10)
10	1,2-dichloroethane	0.62	98(10)	62(100)	64(33)	27(70)
11	1,1,1-trichloroethane	0.68	97(100)	99(66)	117(17)	119(16)
12	Carbon tetrachloride	0.70	117(100)	119(96)	121(33)	82(21)
13	Bromodichloromethane	0.76	127(10)	83(100)	85(66)	129(13)
14	1, 2-dichloropropane	0.83	112(4)	63(100)	65(33)	114(3)
15	Trans-1,3-dichloropropylene	0.86	75(100)	77(33)		
16	Trichloroethylene	0.88	130(90)	132(85)	95(100)	97(66)
17	Benzene	0.90	78(100)	77(19)	52(16)	51(15)
18	Dibromochloromethane	0.93	127(100)	129(78)	131(25)	208(14)
18	Cis-1,3-dichloropropylene	0.93	75(100)	77(33)	110(25)	
18	1,1,2-trichloroethane	0.94	97(100)	99(66)	83(95)	85(60)
20	Bromoform	1.10	173(100)	171(50)	175(49)	252(11)
21	1,1,2,2-tetrachloroethylune	1.23	164(78)	166(100)	129(64)	131(62)
21	1,1,2,2-tetrachloroethane	1.23	83(100)	85(66)	131(7)	133(7)
23	Toluene	1.27	92(65)	91(100)	65(12)	51(6)
24	Chlorobenzene	1.39	112(100)	77(45)	114(33)	51(16)
25	Ethylbenzene	1.59	106(33)	91(100)	51(9)	77(8)

[a] Numbers refer to reconstructed gas chromatogram in Figure C-1.

[b] These compounds were not detected by this method.

[c] These compounds were not available for the spiking solutions

TABLE C-2

VOLATILES DATA

REPORTING LIMITS (μg/L)

COMPOUND	Trip I	Trip II
Bromochloromethane, IS	-	-
Chloromethane	-	-
Bromomethane	-	-
Vinyl chloride	-	-
Chloroethane	-	1
Methylene chloride	1	1
Acrolein	1	7
Acrylonitrile	1	1
Dichlorodifluoromethane	-	-
Trichlorofluoromethane	1	6
1,1-Dichloroethylene	1	5
Trans-1,2-Dichloroethylene	1	1
1,1-Dichloroethane	1	2
Chloroform	1	1
1,2-Dichloroethane	1	1
1,1,1-Trichloroethane	1	1
1,1,2-Trichloroethane	1	1
Carbon tetrachloride	1	1
Bromodichloromethane	1	1
Dibromochloromethane	1	1
Bis-chloromethyl ether	-	-
1,2-Dichloropropane	1	1
Chlorobenzene	1	1
Trans-1,3-dichloropropylene	1	1
Cis-1,3-dichloropropylene	1	1
Trichloroethylene	1	1
Benzene	1	1
Chloroethyl vinyl ether	-	-
Ethyl benzene	1	1
2-Bromo-1-chloropropane, IS	-	-
Bromoform	1	3
1,1,2,2-Tetrachloroethylene	1	1
1,1,2,2-Tetrachloroethane	1	1
1,4-Dichlorobutane, IS	-	-
Toluene	1	1

TABLE C-3

CALIBRATION VALUES FOR CONCENTRATION CALCULATIONS

VOLATILES - CINCINNATI TRIP I

	Slope	Intercept	Reporting Limit µg/L	Reporting Limit Area
Compound				
Bromochloromethane, IS				
Chloromethane	-	-		
Bromomethane	21.746	-27.139	1	1.29
Vinyl chloride	-	-		
Chloroethane	17.255	-22.930	1	1.39
Methylene chloride	9.788	-32.216	1	3.39
Acrolein	375.499	-6.558	1	0.02
Acrylonitrile	12.260	-2.451	1	0.28
Dichlorodifluoromethane	-	-		
Trichloro fluoromethane	13.494	-.659	1	0.12
1,1-Dichloroethane	13.883	-0.0215	1	0.07
Trans-1,2-Dichloroethylene	12.325	.525	1	0.04
1,1-Dichloroethane	3.949	-.215	1	0.31
Chloroform	3.651	.614	1	0.11
1,2-Dichloroethane	95.387	-2.264	1	0.03
1,1,1-Trichloroethane	6.152	.494	1	0.08
1,1,2-Trichloroethane	9.041	-1.663	1	0.29
Carbon tetrachloride	7.326	-.098	1	0.15
Bromodichloromethane	61.947	-.392	1	0.02
Dibromochloromethane	7.596	.535	1	0.06
Bis-chloromethylether	-	-		
1,2-Dichloropropane	222.649	-2.881	1	0.02
Chlorobenzene	3.925	-.890	1	0.48
Trans-1,3-dichloropropane	4.883	-.259	1	0.26
Cis-1,3-dichloropropane	6.787	-2.849	1	0.57
Trichloroethylene	11.569	-2.096	1	0.27
Benzene	2.458	-.859	1	0.76
Chloroethylvinylether	-	-		
Ethyl benzene	8.688	.828	1	0.02
2-Bromo-1-chloropropane, IS				
Bromoform	7.351	.339	1	0.09
1,1,2,2-Tetrachloroethene	14.637	-2.253	1	0.22
1,1,2,2-Tetrachloroethane	3.812	-1.617	1	0.69
1,4-Dichlorobutane, IS				
Toluene	4.563	-3.607	1	1.01

TABLE C-3 (cont'd)

CALIBRATION VALUES FOR CONCENTRATION CALCULATIONS

VOLATILES - CINCINNATI TRIP II

Compound	Slope	Intercept	Reporting Limit µg/L	Reporting Limit Area
Bromochloromethane, IS				
Chloromethane	-	-		
Bromomethane	-	-		
Vinylchloride	-	-		
Chloroethane	66.944	-4.554	1	0.08
Methylene chloride	35.576	-14.818	1	0.45
Acrolein	1739.700	5.798	7	0.001
Acrylonitrile	55.067	-6.808	1	0.15
Dichlorodifluoromethane	-	-		
Trichlorofluoromethane	59.584	5.412	6	0.01
1,1-Dichloroethane	63.118	4.361	5	0.01
Trans-1,2-Dichloroethylene	59.189	-.233	1	0.03
1,1-Dichloroethene	18.397	1.793	2	0.011
Chloroform	17.349	0.775	1	0.02
1,2-Dichloroethane	448.342	-.218	1	0.003
1,1,1-Trichloroethane	29.649	0.093	1	0.03
1,1,2-Trichloroethane	42.268	-.636	1	0.04
Carbon tetrachloride	35.231	-.763	1	0.05
Bromodichloromethane	293.371	-.475	1	0.005
Dibromochloromethane	36.445	0.075	1	0.03
Bis-chloromethylether	-	-		
1,2-Dichloropropane	1034.5	-2.749	1	0.004
Chlorobenzene	18.302	0.167	1	0.05
Trans-1,3-dichloropropylene	23.050	0.428	1	0.03
Cis-1,3-dichloropropylene	31.592	-.668	1	0.06
Trichloroethylene	53.552	-.903	1	0.04
Benzene	11.482	0.630	1	0.04
Chloroethylvinylether	-	-		
Ethyl benzene	41.696	-1.880	1	0.07
2-Bromo-1-chloropropane, IS				
Bromoform	34.510	2.331	3	0.02
1,1,2,2-Tetrachloroethene	67.633	0.656	1	0.005
1,1,2,2-Tetrachloroethane	17.904	-.241	1	0.07
1,4-Dichlorobutane, IS				
Toluene	20.991	-1.201	1	0.11

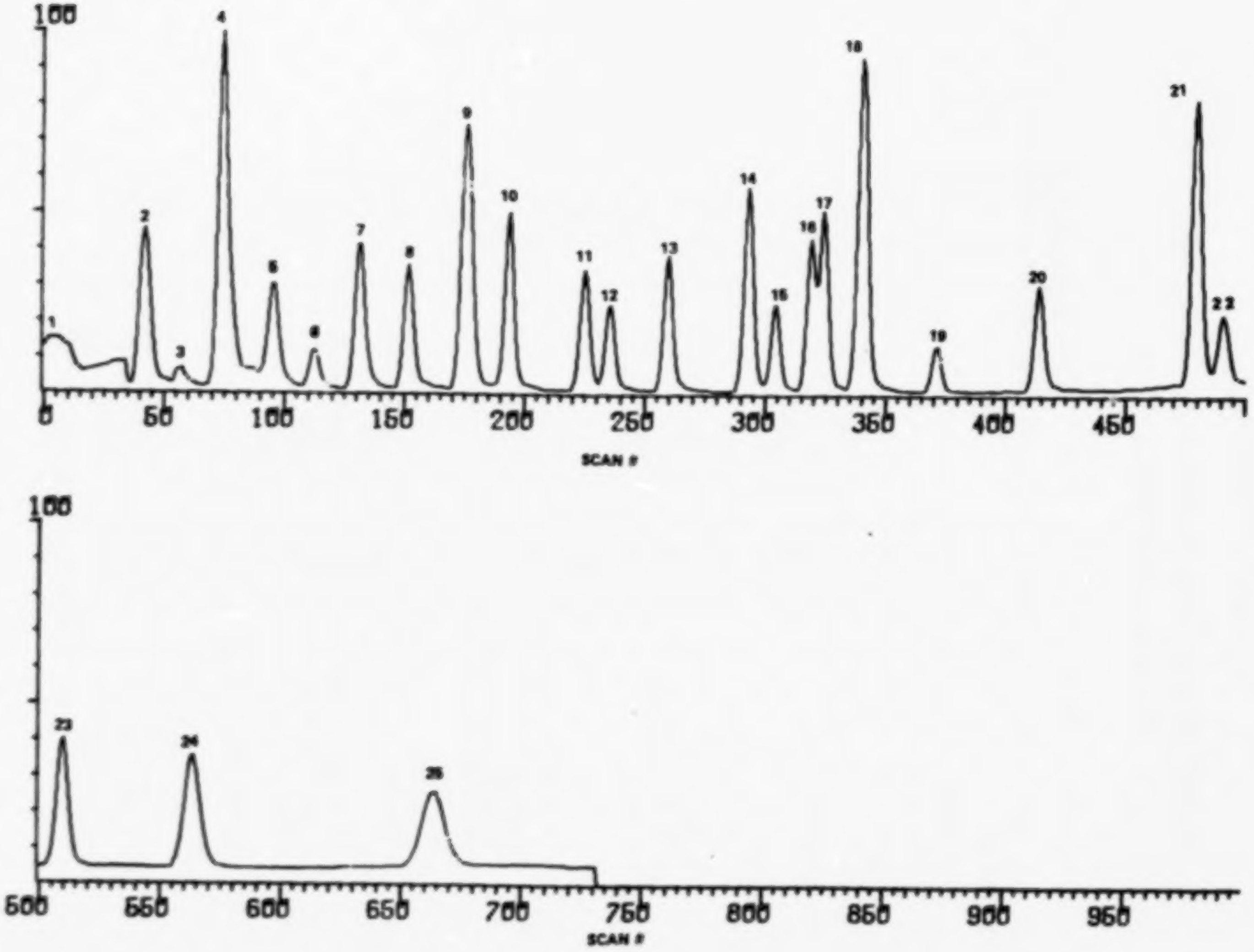

FIGURE C-1. Volatiles Reconstructed Gas Chromatogram

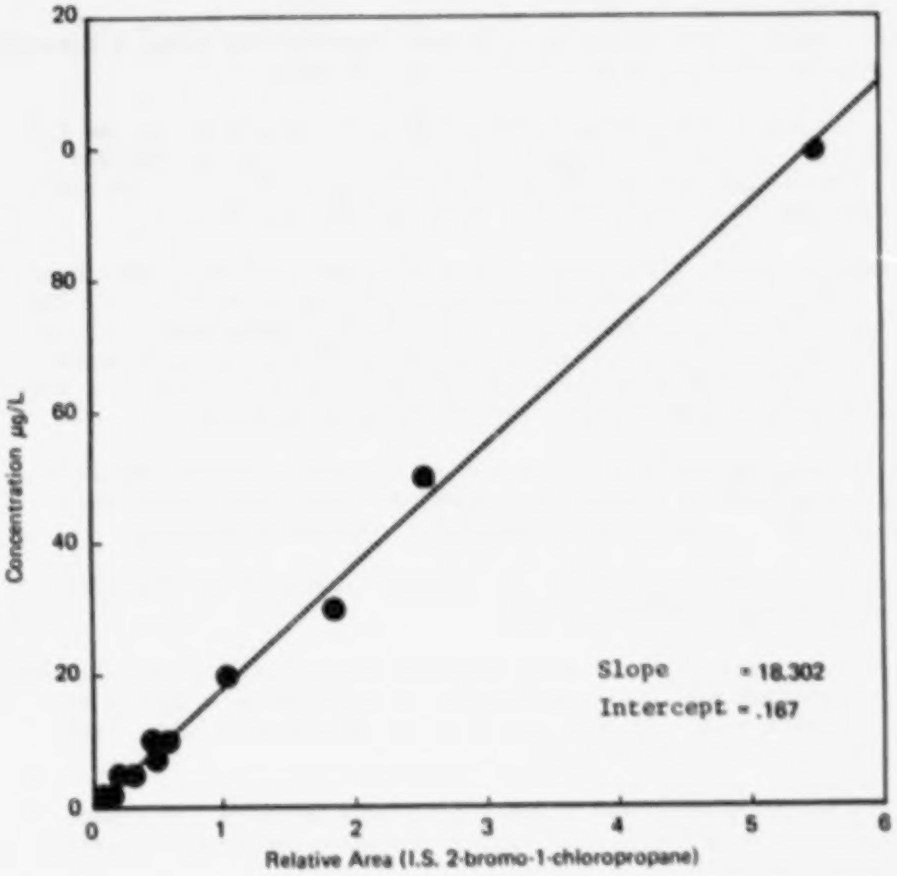

FIGURE C-2. **CALIBRATION CURVE – CHLOROBENZENE**

The extract was then dried by filtering through anhydrous Na_2SO_4 and silanized glass wool.[*] The dried extract was concentrated using a Kuderna Danish apparatus with macro, then micro-Snyder columns.

The concentrated sample was chromatographed onto a glass 6 ft x 2 mm I.D. gas chromatographic column (2,7) packed with 1% SP 1240 DA on 100/200 Supelcoport. The column was programmed from 85°C (isothermal 1 minute) to 185°C (isothermal 20 minutes) at the rate of 10°C per minute.

The gas chromatograph was interfaced with a Finnigan 4000 mass spectrometer (GC/MS). The mass spectrometer was interfaced with an Eclipse C200 computer system. Tuning requirements for the GC/MS system were met for this method, using decafluorotriphenylphosphine (DFTPP), as recommended by the protocol. Relative peak areas of the specific analytical m/e ions were calculated using d_{10}-anthracene as the internal standard.

Table C-4 lists the compounds analyzed for in the Acid method, the relative retention times and the analytical ions (m/e and their intensity) used to quantify and identify the compounds in the Acids category.

Table C-5 lists the reporting limits for samples collected on the first and second trips to the Cincinnati POTW.

Table C-6 lists the calibration values used for concentration calculations. These values were based on least squares linear regression analysis of the daily calibration data. Values for Trip II incorporate both first trip and second trip calibration data.

Figure C-3 is a reconstructed gas chromatogram of a mixture containing the compounds in the Acid category. Figure C-4 is a sample calibration curve for 2-chlorophenol.

Comments on Acids' Method

The original protocol[1] recommended that the compounds in the Acid category be chromatographed on a Tenax-GC column. Recommendations[2] from the EPA indicated that Supelco's 1% SP 1240 DA gas chromatographic column had better chromatographic characteristics than Tenax-GC. The 1% SP 1240 DA column was used in this program with success.

Problems were encountered in using d_{10}-anthracene as an internal standard in the acidic environment. The deuterium was exchanging for hydrogen forming d_9- and d_8- anthracene. This problem was circumvented by combining the d_{10} anthracene analytical ions (m/e 188, 187, 186) for quantification.

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[*] Na_2SO_4 and silanized glass wool were cleaned by 24-hour Soxhlet extraction with methylene chloride. The Na_2SO_4 was dried in a furnace at 500°C, followed by 130°C storage until required. The glass wool is stored at 100°C, until required.

TABLE C-4

ACIDS COMPOUND CATEGORY

Peak #[a]	Compound	Relative Retention Time	Analytical ions m/e (intensity)			
7	d_{10}-Anthracene, I.S.	1.00	187+188(100)	94(19)	80(18)	189(14)
1	2-Chlorophenol	.35	128(100)	130(31)	64(54)	92(20)
2	2-Nitrophenol	.40	139(100)	65(35)	64(22)	63(22)
3	Phenol	.47	94(100)	66(19)	65(17)	
4	2,4-Dimethylphenol	.55	122(100)	107(90)	121(55)	91(20)
4	2,4-Dichlorophenol	.57	162(100)	164(65)	98(40)	63(65)
5	2,4,6-Trichlorophenol	.71	196(100)	198(96)	200(31)	132(28)
6	p-Chloro-m-cresol[b]	.79	142(100)	107(80)	144(32)	77(24)
8	2,4-Dinitrophenol	1.06	63(59)	184(100)	154(53)	91(41)
8	4,6-Dinitro-o-cresol	1.07	198(100)	77(38)	168(35)	
9	Pentachlorophenol	1.22	266(100)	264(62)	268(63)	165(54)
10	4-Nitrophenol	2.15	65(100)	139(90)	109(72)	81(33)

[a] Numbers refer to reconstructed gas chromatogram in Figure C-3.

[b] This compound was not available for the spiking solution in the first Cincinnati trip.

TABLE C-5

ACIDS DATA, μg/L

COMPOUND		TRIP I	TRIP II
D_{10}-anthracene, IS		10	10
2-chlorophenol		10	10
2-nitrophenol		10	10
phenol		10	10
2,4-dimethylphenol		10	10
2,4-dichlorophenol		10	10
2,4,6-trichlorophenol		10	10
p-chloro-m-cresol[a]		–	10
2,4-dinitrophenol		40	25
4,6-dinitro-2-cresol		40	25
pentachlorophenol		10	10
4-nitrophenol		25	25

[a] Not included in standard mix for Trip I.

TABLE C-6

CALIBRATION VALUES FOR CONCENTRATION CALCULATIONS

ACIDS - CINCINNATI TRIP I

Sample Number and Compound	Slope	y-Intercept	Reporting Limit	
			µg/L	area
D_{10}- anthracene, IS				
2-chlorophenol	6.3766	9.5898	10	0.64
2-nitrophenol	28.6662	12.3606	13	0.022
phenol	13.4520	9.4830	10	0.038
2,4-dimethylphenol	11.7456	9.0489	10	0.081
2,4-dichlorophenol	17.5013	7.0047	10	0.171
2,4,6-trichlorophenol	22.8957	7.9523	10	0.089
4-chloro-3-cresol [a]	-	-		
2,4-dinitrophenol	61.9962	39.9027	40	0.002
4,6-dinitro-2-cresol	40.8612	30.4301	40	0.234
pentachlorophenol	49.8636	12.0886	13	0.018
4-nitrophenol	38.9658	23.6813	24	0.008

[a] Not included in standard mix for Trip I.

TABLE C-6 (Cont'd)

CALIBRATION VALUES FOR CONCENTRATION CALCULATIONS

ACIDS - CINCINNATI TRIP II

Sample Number and Compound	Slope	Intercept	Reporting Limit	
			μg/L	area
D_{10}-anthracene, IS				
2-chlorophenol	6.4308	9.7600	10	0.037
2-nitrophenol	30.2558	5.8283	10	0.138
phenol	14.0816	2.2864	10	0.548
2,4-dimethylphenol	12.0957	6.2732	10	0.308
2,4-dichlorophenol	17.9196	4.9780	10	0.280
2,4,6-trichlorophenol	23.5207	5.6063	10	0.187
4-chloro-3-cresol [a]	19.9290	0.7696	10	0.463
2,4-dinitrophenol	73.4759	19.4594	25	0.075
4,6-dinitro-2-cresol	46.9461	13.7729	25	0.239
pentachlorophenol	51.9267	3.7533	25	0.409
4-nitrophenol	41.8218	11.6772	25	0.319

[a] These values based only on calibration points from 2nd trip; all others based on data from both trips.

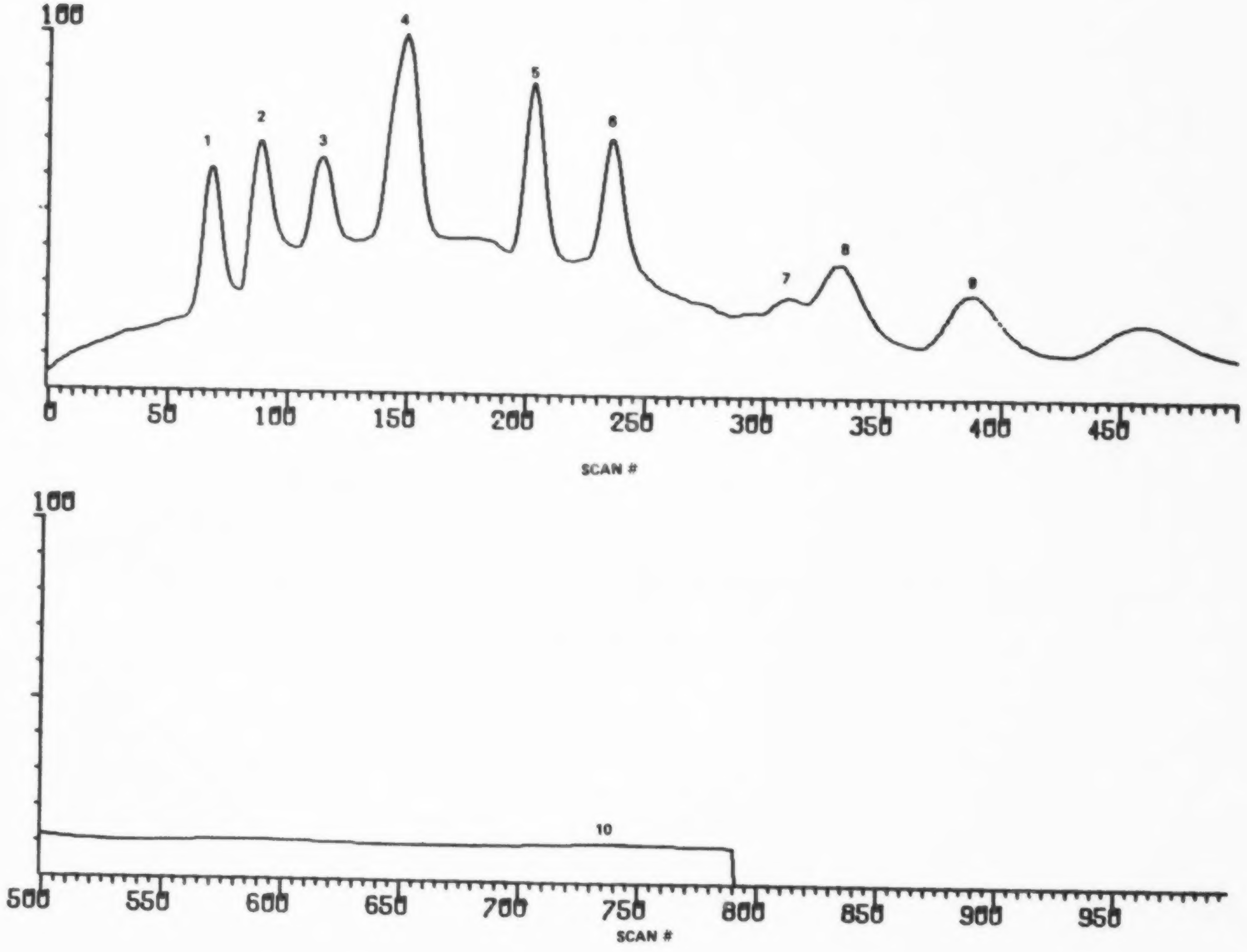

FIGURE C-3. Acids Reconstructed Gas Chromatogram

ACIDS

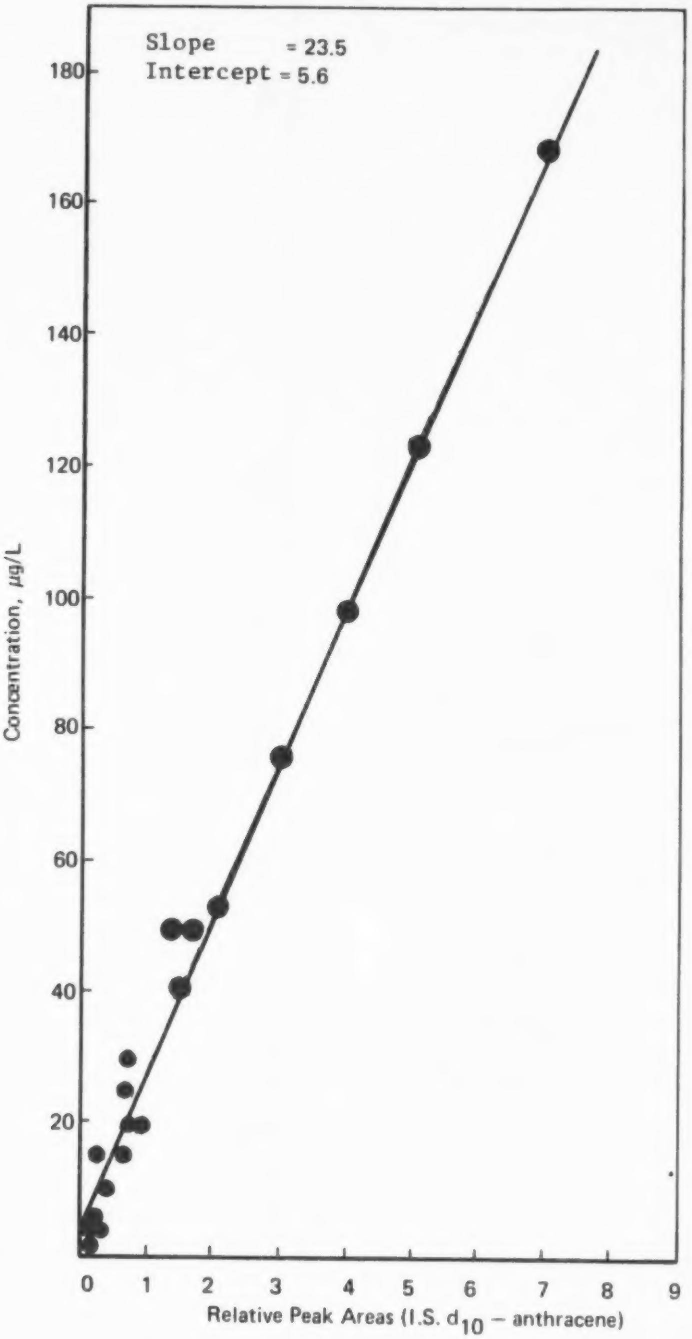

FIGURE C-4. **CALIBRATION CURVE**
2, 4, 6 – TRICHLOROPHENOL

BASE/NEUTRAL METHOD

A one-liter sample aliquot was adjusted to a pH of approximately 11 with 6N NaOH. The sample was extracted sequentially with 250 mL: 100 mL: 100 mL of methylene chloride and centrifuged to break emulsions within 48 hours of receipt in the laboratory. The extracted sample was stored in an amber glass bottle at 4°C, while awaiting drying and concentrating.

The extract was then dried by filtering through anhydrous Na_2SO_4 and silanized glass wool.* The dried extract was concentrated using a Kuderna-Danish apparatus with macro, then micro-Snyder columns.

The concentrated extract was chromatographed onto a glass 6 ft. x 2 mm I.D. gas chromatographic column packed with 1% SP 2250, on 100/120 mesh Supelcoport.(2,7) The column was programmed from 50°C (isothermal 4 minutes) to 265°C (isothermal 20 minutes) at a rate of 8°C per minute.

The gas chromatograph was interfaced with a Finnigan 4000 mass spectrometer (GC/MS). The mass spectrometer was interfaced with an Eclipse C200 computer system. Tuning requirements for the GC/MS system were met for this method, using decafluorotriphenylphosphine (DFTPP). Relative peak areas of the specific analytical m/e ion were calculated using d_{10}-anthracene as the internal standard.

Table C-7 lists the compounds analyzed for in the Base/Neutral method, the relative retention times and the analytical ions (m/e and their intensity) used to quantify and identify the compounds in the Base/Neutral category.

Table C-8 lists the reporting limits for samples collected on the first and second trips to Cincinnati.

Table C-9 lists the calibration values used for the concentration calculations. The same calibration numbers were used for both trips.

Figure C-5 is a reconstructed gas chromatogram of a mixture containing all the compounds analyzed in the Base/Neutral category. Figure C-6 is a sample calibration curve for naphthalene.

Comments on the Base/Neutral Method

The original screening protocol[1] recommended that the compounds in the Base/Neutral category be reported at a minimum concentration of 10 μg/L. In this program, the method was sensitive for benzo(a)pyrene, indeno (1,2,3-c,d) pyrene and benzo (g,h,i) pyrene to concentration levels of 5 μg/L. Hexachloroethane, bis (2-chloroethyl) ether, nitrobenzene, nitroso-di-n-propylamine, 1,2,4-trichlorobenzene and benzidine had reporting limits of 20 μg/L.

Problems were encountered with recovery of benzidine during analysis of the samples from the second trip to Cincinnati. Benzidine was believed

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* See Acid method for description of Na_2SO_4 and glass wool preparation.

TABLE C-7

BASE/NEUTRALS COMPOUND CATEGORY

Peak #[a]	Compound	Relative Retention Times[e]	Analytical Ions m/e (intensity)			
20	d_{10}-Anthracene, I.S.	1.00	188(100)	94(19)	80(18)	189(14)
1	1,3-Dichlorobenzene	.25	146(100)	148(64)	113(12)	111(36)
2	1,4-Dichlorobenzene	.25	146(100)	148(64)	113(12)	111(36)
3	1,2-Dichlorobenzene	.25	146(100)	148(64)	113(12)	111(36)
3	Hexachloroethane	.32	117(100)	199(61)	201(99)	119(96)
4	bis(2-chloroisopropyl)ether[d]	.35	45(100)	77(19)	79(12)	121(26)
	bis(chloromethyl)ether[b]	.38	79(100)	49(47)	81(33)	50(16)
3	bis(2-chloroethyl)ether	.38	63(100)	93(99)	95(33)	27(80)
6	Hexachlorobutadiene	.45	225(100)	223(63)	227(65)	260(43)
8	bis(2-chloroethoxy)methane[d]	.48	93(100)	63(65)	95(32)	123(22)
5	Nitrobenzene	.49	77(100)	123(51)	65(15)	51(41)
6	N-Nitrosodi-n-propylamine	.49	130 (22)	42(64)	43(100)	41(46)
7	1,2,4-Trichlorobenzene	.49	180(100)	182(96)	184(31)	145(23)
8	Naphthalene	.52	128(100)	127(12)	129(11)	64 (7)
	Hexachlorocyclopentadiene[c]	.52	237(100)	239(65)	235(63)	272(12)
9	Isophorone	.56	82(100)	67(53)	95(28)	41(22)
10	2-Chloronaphthalene	.69	162(100)	164(32)	127(27)	126(13)
11	Acenaphthylene	.75	152(100)	153(16)	151(17)	76(17)
12	Acenaphthene	.77	154(100)	153(95)	152(53)	76(23)
13	Dimethylphthalate	.80	163(100)	164(10)	194(11)	77(20)
14	2,6-Dinitrotoluene	.81	165(100)	63(48)	89(48)	90(41)
15	4-chlorophenyl phenyl ether[d]	.81	204(100)	206(34)	141(29)	77(23)
15	Fluorene	.85	166(100)	165(80)	167(14)	
16	2,4-Dinitrotoluene	.87	165(100)	89(65)	63(31)	90(29)
17	1,2-Diphenyl hydrazine	.87	77(100)	105(32)	182(28)	93(10)
17	Diethyl phthalate	.88	149(100)	178(25)	150(10)	177(10)
18	N-Nitrosodiphenylamine[d]	.90	169(100)	168(60)	167(40)	
19	Hexachlorobenzene	.91	284(100)	286(79)	282(51)	142(30)
19	4-Bromophenyl phenyl ether[d]	.92	248(100)	250(99)	141(45)	169(24)
20	Anthracene/Phenanthrene	1.00	178(100)	179(15)	176(15)	89(12)
21	Di-n-butyl phthalate	1.09	149(100)	150(15)	104 (9)	41(28)
22	Fluoranthene	1.18	202(100)	101(26)	203(17)	200(15)
23	Pyrene	1.21	202(100)	101(23)	203(17)	200(15)
24	Benzidine	1.31	184(100)	185(15)	183(11)	92 (8)
25	Butyl benzyl phthalate[d]	1.33	149(100)	91(50)	206(18)	104(12)
26	Bis(2-ethyl hexyl)phthalate	1.36	149(100)	167(40)	279(26)	57(35)
26	Di-n-octyl phthalate[d]	1.36	149(100)	167(40)	279(26)	57(35)
27	Chrysene[d]	1.39	228(100)	229(19)	226(19)	114(18)
28	Benzo(a)anthracene	1.39	228(100)	229(19)	226(19)	114(18)
	2,3,7,8-Tetrachloro-dibenzo-p-dioxin[d]	1.48	322(100)	320(77)	324(49)	326(11)
29	3,3-Dichlorobenzidine[d]	1.50	252(100)	254(66)	126(16)	
30	Benzo(b)fluoranthene[d]	1.60	252(100)	253(23)	250(18)	126(23)
30	Benzo(k)fluoranthene[d]	1.60	252(100)	253(23)	250(18)	126(23)
31	Benzo(a)pyrene	1.65	252(100)	253(23)	250(18)	126(23)
32	Indeno(1,2,3-c,d)pyrene[d]	2.05	276(100)	277(25)	138(28)	274(20)
32	Dibenzo(a,h)anthracene	2.07	278(100)	279(24)	139(24)	276(20)
33	Benzo(g,h,i)perylene	2.20	276(100)	277(25)	138(37)	274(20)
	N-Nitrosodimethylamine[d]		42(100)	74(90)	43(50)	
	Endosulfan sulfate[d]					
	2-Chloroethyl vinyl ether[d]		106 (20)	63(95)	65(32)	

[a] Numbers refer to reconstructed gas chromatogram in Figure C-5.

[b] Method does not work for this compound: reported to have a short half-life in water.

[c] Method does not work for this compound.

[d] Compounds not available for addition to the spiking solution.

[e] The reported relative retention times are based on the latest chromatographic data. Chromatogram in Figure C-5 is from some earlier work.

TABLE C-8

REPORTING LIMITS, µg/L

BASE/NEUTRAL DATA

Compound	TRIP I		TRIP II
D10 Anthracene			
1,3-Dichlorobenzene	30		30
1,4-Dichlorobenzene			
1,2-Dichlorobenzene			
Hexachloroethane	20		20
Bis (2-Chloroisopropyl) Ether			
Bis (Chloromethyl) Ether			
Bis (2-Chloroethyl) Ether	20		20
Nitrobenzene	20		20
Hexachlorobutadiene	10		10
Nitroso Di-n-Propylamine	20		20
1,2,4-Trichlorobenzene	20		20
Naphthalene	10		10
Hexachlorocyclopentadiene			
Bis (2- Chloroethoxy)Methane			
Isophorone	10		10
2- Chloronaphthalene	10		10
Acenaphthylene	10		10
Acenaphthene	10		10
Dimethyl Phthalate	10		10
4-Chloro-Phenyl Phenyl Ether			
Fluorene	10		10
2,6-Dinitrotoluene	10		10
2,4-Dinitrotoluene	10		10
1,2-Diphenyl Hydrazine	10		10
Diethyl Phthalate	10		10
Di-n-Butylphthalate	10		10
Butylbenzyl Phthalate	10		10
Bis (2-Ethylhexyl)Phthalate	10		10
N-Nitrosodiphenylamine			
Hexachlorobenzene	10		10
4-Bromophenyl Phenyl Ether			
Phenanthrene	10		10
Anthracene			
Fluoranthene	10		10
Pyrene	10		10
Benzidine	20		20
Chrysene			
Benzo (a) Anthracene	10		10
3,3'-Dichlorobenzidine			
Benzo (b)fluoranthene			
Benzo(k)fluoranthene			
Benzo (a) Pyrene	10		5
Indeno (1,2,3-CD) Pyrene			
Dibenzo (a,h)Anthracene	10		5
Benzo (ghi) Perylene	10		5
Endrin - Aldehyde			
2,3,7,8-Tetrachlorodibenzo - p-Dioxin			

TABLE C 9

CALIBRATION VALUES FOR CONCENTRATION CALCULATIONS

BASE/NEUTRALS - CINCINNATI TRIPS I & II[a]

Compound	Slope	Intercept	Reporting Limit	
			µg/L	area
1,3 Dichlorobenzene	5.134	27.398	30	0.51
1,4 Dichlorobenzene				
1,2 Dichlorobenzene				
Hexachloroethane	9.074	9.467	20	1.16
Bis(chloromethyl)ether	-	-	-	-
Bis(2-chloroethyl) ether	4.924	10.333	20	1.96
Bis(2-chloroisopropyl) ether	-	-		
N-Nitrosodimethylamine	-	-		
Nitrosodi-n-propylamine	32.680	9.060	20	0.33
Nitrobenzene	4.413	10.060	20	2.25
Hexachlorobutadiene	15.578	6.576	10	0.22
1,2,4-Trichlorobenzene	7.598	9.390	20	1.40
2-Chloroethyl vinyl ether	-	-		
Bis(2-chloroethoxy) methane	-	-		
Naphthalene	2.408	6.099	10	1.62
Isophorone	2.404	6.181	10	1.59
Hexachlorocyclopentadiene	-	-		
2-Chloronaphthalene	5.031	3.010	10	1.39
Acenaphthylene	3.706	2.090	10	2.13
Acenaphthene	5.833	0.730	10	1.59
Dimethyl phthalate	5.000	-0.302	10	2.06
2,6-Dinitrotoluene	28.835	2.096	10	0.27
4-Chlorophenyl phenyl ether	-	-		
Fluorene	5.745	-0.585	10	1.84
2,4-Dinitrotoluene	20.732	4.047	10	0.29
Diethyl phthalate	5.218	-5.134	10	2.90
1,2-Diphenylhydrazine	3.314	0.500	10	2.87
N-Nitrosodiphenylamine	-	-		
Hexachlorobenzene	28.959	0.661	10	0.32
4-Bromophenyl phenyl ether	-	-		

TABLE C-9 (Cont'd)

CALIBRATION VALUES FOR CONCENTRATION CALCULATIONS

BASE/NEUTRALS - CINCINNATI TRIPS I & II[a]

Compound	Slope	Inter-cept	Reporting Limit	
			µg/L	area
Anthracene	4.826	-3.892	10	2.88
Phenanthrene				
Di-n-butyl phthalate	3.277	-6.899	10	5.16
Fluorene	8.437	-1.036	10	1.31
Pyrene	5.202	-0.984	10	2.11
Benzidine	14.409	11.568	20	0.59
Butyl benzyl phthalate[b]	(5.097)	(-4.654)	(10)	(2.88)
Bis(2-ethylhexyl) phthalate	5.097	4.654	10	2.88
Di-n-octyl phthalate	-	-		
Chrysene	7.251	1.908	10	1.11
Benzo(a)anthracene				
3,3'-Dichlorobenzidine	-	-		
Benzo(b)fluoranthene	-	-		
Benzo(k)fluoranthene	-	-		
Benzo(a)pyrene	8.754	2.342	10	0.87
Indeno (1,2, -c,d) pyrene	-	-		
Dibenzo (a,h) nthracene	17.509	2.368	10	0.44
Benzo (g,h,i) perylene	21.083	2.473	10	0.36

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[a] Calibration data for Trip I used to calculate these values.

[b] Butylbenzyl phthalate was not in calibration mix. Calibration values for butylbenzyl phthalate were taken from Bis(2-ethylhexyl)phthalate data in order to obtain approximate concentrations.

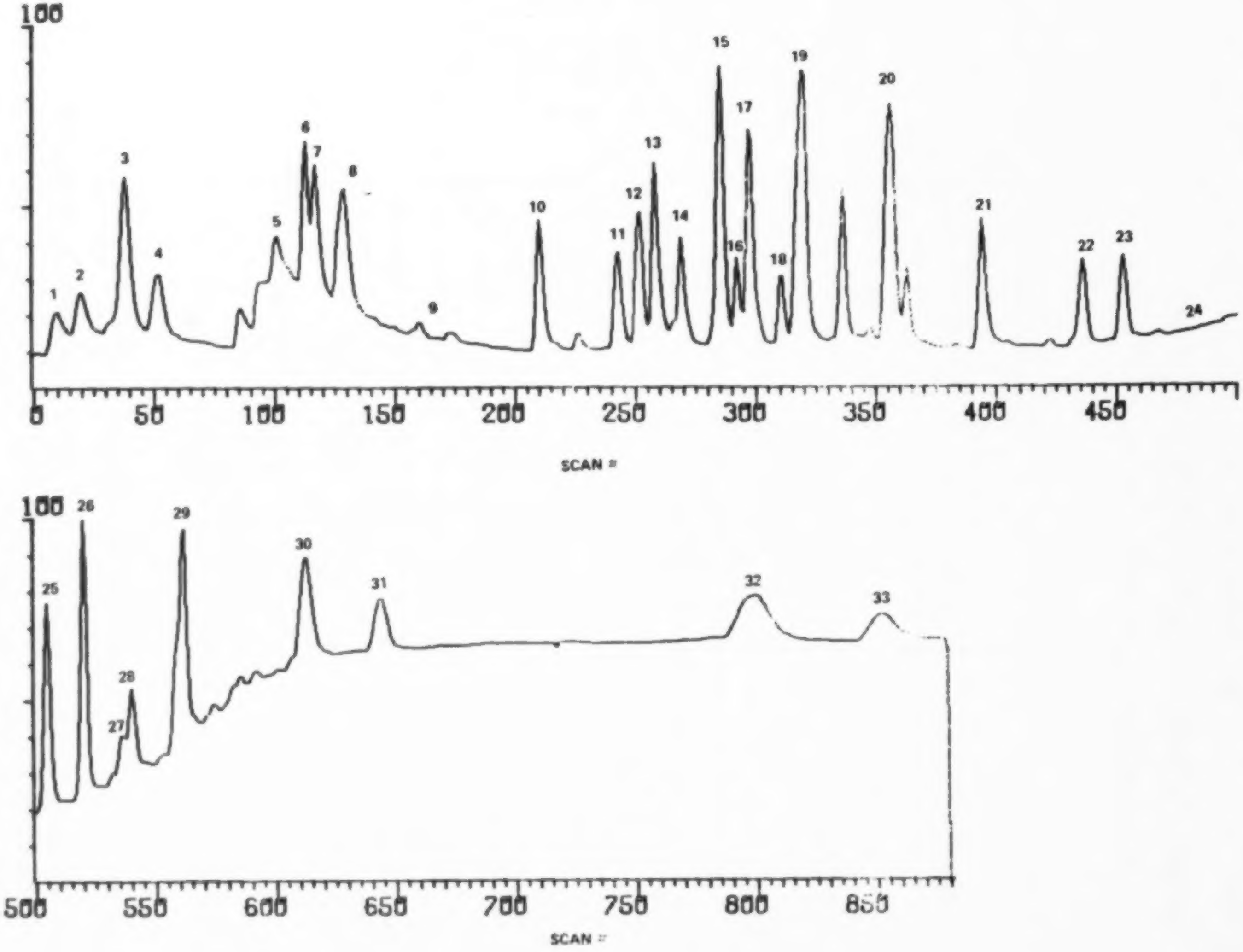

FIGURE C-5. Base/Neutral Reconstructed Gas Chromatogram

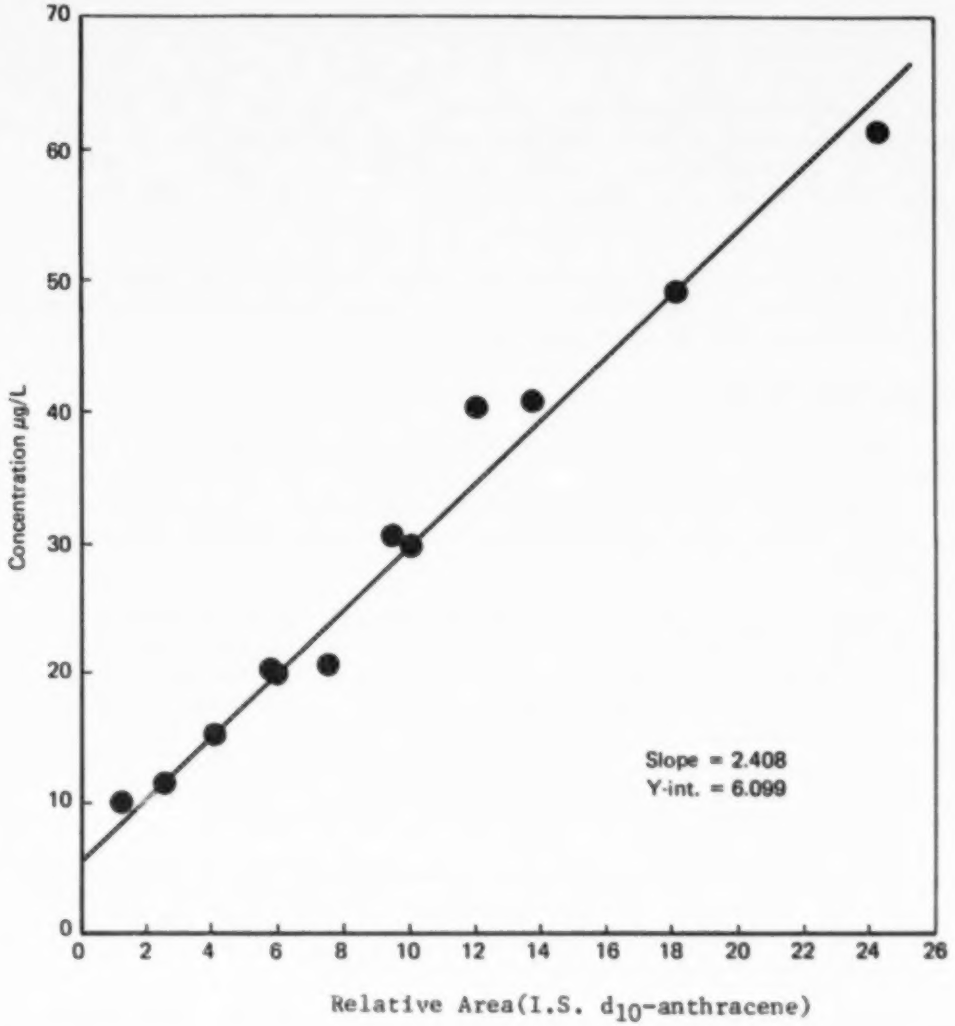

FIGURE C-6. **CALIBRATION CURVE – NAPHTHALENE** to have chromatography problems on the 1% SP 2250 gas chromatographic column.(1,2)

Improved benzidine chromatography was reported(2,7) using the 3% SP 2250 DB(2,7) gas chromatographic column; however, serious contamination of the mass spectrometer ion source was encountered when this column was used. Therefore the original EPA recommended[1] 1% SP 2250 column was used for this program.

Bis(2-chloromethyl) ether was not detected, using the method as described due to its extremely short half-life in water. Hexachlorocyclopentadiene also was not detected, for unknown reasons.

PESTICIDES AND PCBs METHOD

A one-liter sample aliquot was extracted three times with 60 mL of 15% methylene chloride/hexane, within 48 hours of receipt in the laboratory. The organic extract was centrifuged, to break emulsions. The extracted sample was stored in an amber glass bottle at 4°C while waiting for drying and concentrating.

The extract was dried by filtering through anhydrous sodium sulfate and silanized glass wool.* The dried organic extract was concentrated to 10 mL using a Kuderna-Danish apparatus. The concentrated organic extract was chromatographed onto a column packed with cleaned and dried Florisil.** Three fractions were eluted using 200 mL each of the following solvents: 6% diethyl ether/petroleum ether, 15% diethyl ether/petroleum ether and 50% diethyl ethyl/petroleum ether. Each fraction was concentrated to 10 mL, with three rinses of hexane to exchange hexane for the other solvent.

The samples were analyzed using a Hewlett-Packard 5840A gas chromatograph, equipped with a ^{63}Ni electron capture detector. The column used for the analysis was a 6-ft. x 4-mm I.D. silane-treated glass column packed with 1.5% SP 2250/1.95% SP 2401 on 100/120 mesh Supelcoport.

The column temperature was 200°C (isothermal). The injector temperature was 250°C, the manifold temperature was 270°C and the detector temperature was 300°C. The carrier gas was 95% Argon/5% Methane at a flow rate of 75 mL/min.

The Aldrin tune[7] was run daily to check the sensitivity of the electron capture detector. To meet the minimum sensitivity requirements, 100 pg of Aldrin was injected on column; the aldrin response should be 50% of full scale with 2% noise.

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* See Acid method for the description of Na_2SO_4 and silanized glass wool preparation.

** The Florisil was cleaned by washing in boiling water, drying for four hours at 130°C, and calcinating overnight at 500°C.

Table C-10 lists the compounds analyzed for in the Pesticide and PCB method, the relative retention times, and the Florisil eluent fraction for the individual compounds.

If priority pollutant pesticides or PCBs were detected in a sample by GC/ECD, the identity was confirmed by GC/MS. The full mass spectra were used for the identification.

Figure C-7 is a gas chromatogram of a mixture containing the priority pollutant pesticides and PCBs. Figure C-8 is a sample calibration curve for Aldrin.

Comments on Pesticides and PCB Method

Values below 1 μg/L cannot be quantified since the GC/MS system is not sensitive to amounts less than 1 μg/L and the GC/ECD system cannot quantify reliably below this level.

The method was not found to be sufficiently selective to detect the PCBs and chlordane, when present at the same concentration levels as the other pesticides.

TOTAL CYANIDES METHOD

There have been problems with this analysis due to the fact that the EPA Screening Protocol is not explicit concerning the final NaOH concentration required for optimum color development. It was determined experimentally that the final solution of 1.2N NaOH, containing the cyanid to be analyzed, must be diluted 5:1 in order to achieve the correct pH for optimum color development. The procedure described below includes this dilution and has been used to obtain reproducible analyses for total cyanides in aqueous samples.

A 500 mL sample aliquot was transferred to a one-liter boiling flask. This aliquot was acidified by adding 25 mL concentrated sulfuric acid. After 3 minutes, 10 mL cuprous chloride reagent (20 g Cu_2Cl_2/1L HCl and H_2O) was added to the acidified sample aliquot. This sample was refluxed using a vacuum pump and heating mantle. The vacuum and heat were regulated such that the samples bubbled at a rate of 1 to 2 bubbles per second. The resulting HCN gas was collected in 50 mL 1.2N NaOH in an absorbing tube. After one hour, the heat was turned off and the sample was allowed to cool for 15 minutes (the vacuum remained on). After the sample cooled, the NaOH solution in the absorbing tube was transferred to a 250 mL volumetric and diluted to 250 mL with deionized, distilled water with organics removed by carbon adsorption.

A 50 mL aliquot of the above diluted NaOH solution was transferred to a 100 mL volumetric and 15 mL of 1M sodium dihydrogen phosphate was added. The cyanide ion was converted to cyanogen chloride, by adding 2 mLs of a 1% (w:v) Chloramine T solution. The cyanogen chloride was then complexed with pyridine-barbituric acid, by adding 5 mLs of the pyridine-barbituric acid reagent. The resulting solution was diluted to 100 mLs with deionized, distilled water. The absorbance was read at 578 nm, using a Perkin-Elmer Coleman 55 Spectrophotometer.

TABLE C-10

PESTICIDES AND PCBs

			Florisil Eluent	
Peak No.[a]	Compound	Relative Retention Times[b]	6% diethyl ether/petroleum ether	15% diethyl ether/ petroleum ether
1	Alpha BHC	0.55	X	
2	Gamma BHC	0.69	X	
3	Beta BHC	0.79	X	
4	Heptachlor	0.83	X	
5	Delta BHC	0.90	X	
6	Aldrin	1.00	X	
7	Heptachlor Epoxide	1.50	X	
8	Endosulfan I	1.88	X	
9	DDE	2.14	X	
10	Dieldrin	2.28		X
11	Endrin	2.76		X
12	Endosulfan II	3.31	X	
12	DDD	3.31	X	
13	DDT	3.90	X	
	Chlordane[c]		X	
	Toxaphene[d]			X
	Arochlor 1016[c]		X	
	Arochlor 1221[d]		X	
	Arochlor 1232[c]		X	
	Arochlor 1242[c]		X	
	Arochlor 1248[c]		X	
	Arochlor 1254[c]		X	
	Arochlor 1260[c]		X	

[a] Peak numbers refer to figure C-7.

[b] 6 ft. x 4mm I.D. 1.5% SP 2250/1.95% Sp 2401 on 100/120 mesh Supelcoport - 200°C (isothermal).

[c] Compounds not detected by this method when present at the same concentration levels as pesticides.

[d] Compounds not included in the spiking solution.

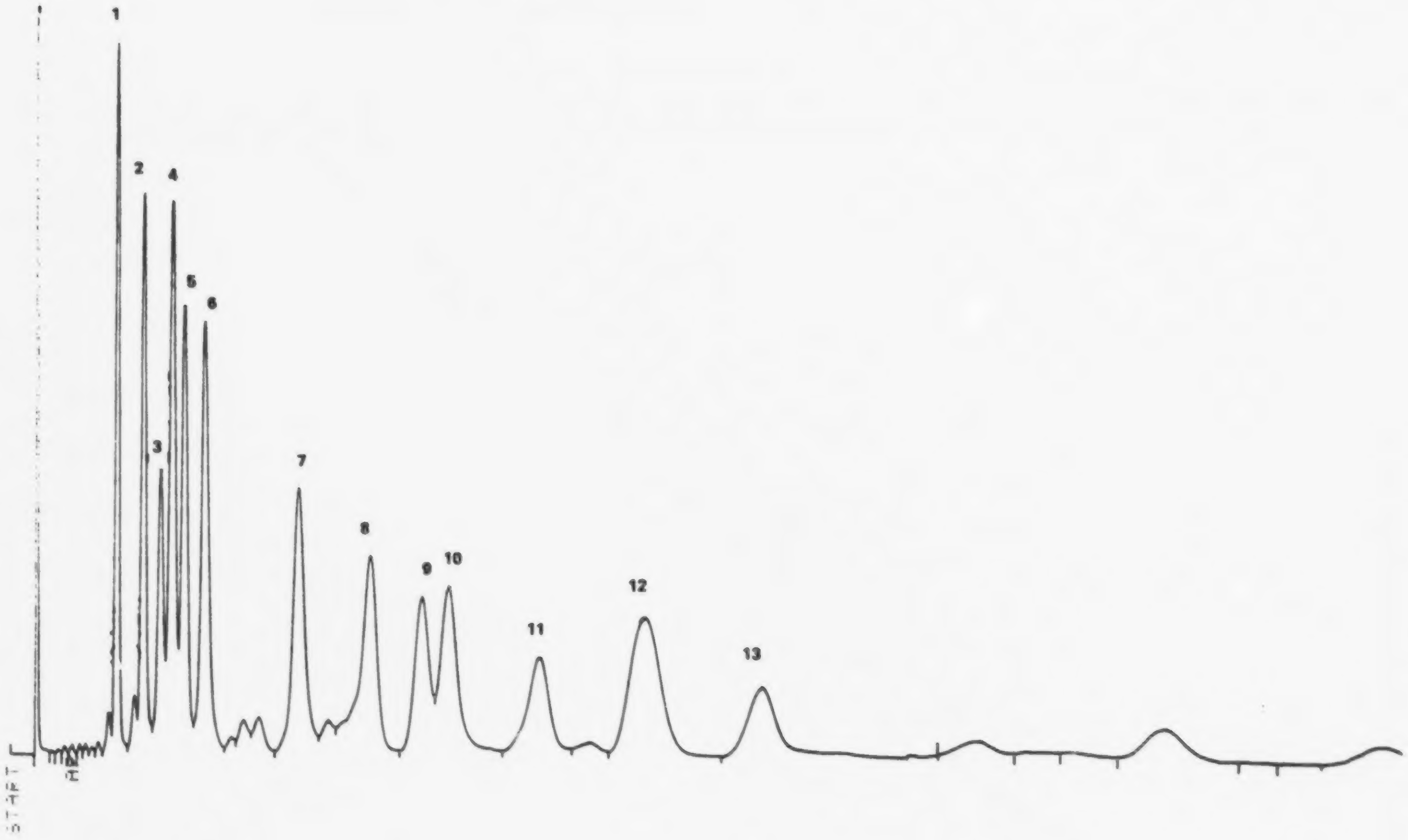

FIGURE C-7. **PESTICIDES CHROMATOGRAM**

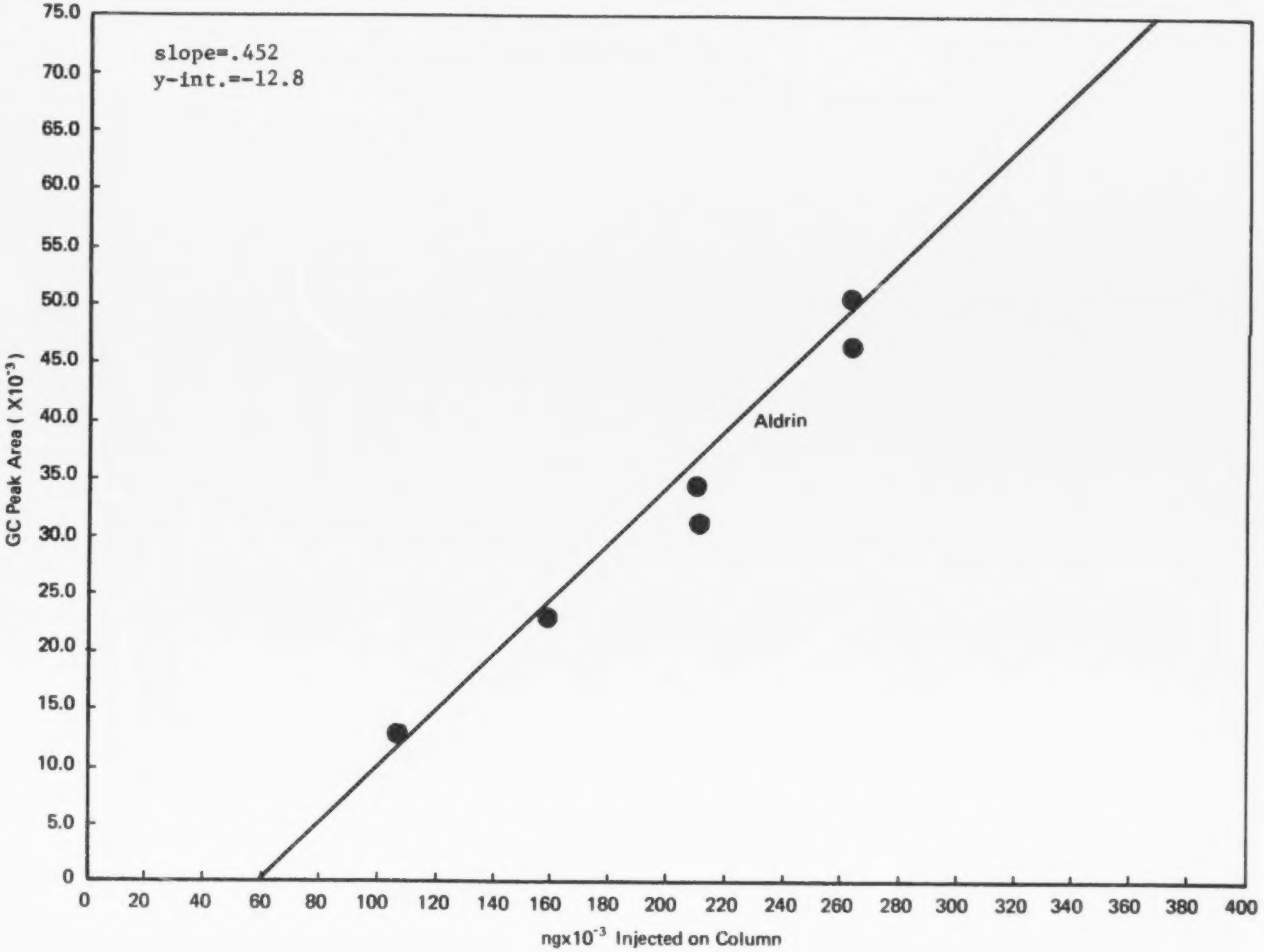

FIGURE C-8. **CALIBRATION CURVE – ALDRIN**

Figure C-9 is a sample calibration curve for total cyanides.

The reporting limit for the total cyanides method is 20 μg/L.

TOTAL PHENOLS METHOD

Samples were preserved in the field by addition of sulfuric acid to a pH of less than 4, followed by addition of $CuSO_4$. In the lab, a 500 mL aliquot of the sample was transferred to a one-liter boiling flask and distilled. The distillate was buffered with ammonium chloride and was made basic (pH 10 ± 0.2) with ammonium hydroxide. 4-Aminoantipyrine and potassium ferricyanide were added, forming an antipyrine dye with the phenol in the sample. The dye was extracted with chloroform. The absorbance at 460 nm was measured. The spectrophotometer used for the measurement was a Perkin-Elmer Coleman 55.

Figure C-10 is a sample calibration curve for total phenols.

Comments on the Total Phenol Method

The reporting limit for the total phenols method is 10 μg/L.

The analytical results for the samples collected on the first and second trips to the Cincinnati POTW were approximately the same. It was suspected that this method may be measuring a contaminant, rather than total phenols, since phenol itself only occurs in about one-third of the samples, as determined by GC/MS.

METALS METHOD

The procedures specified in the EPA protocol[1] were modified to include 1) calibration using the method of standard additions for all flameless AA analyses and 2) calculation of method detection limits. The following is a summary of the resulting procedures.

Sample Preparation. Spiking solutions added to QC samples (i.e., raw wastewater spikes and method reference standards), were prepared by volumetric dilution of 1000 ppm aqueous standards of the respective elements. The concentration and volume of spiking solution added were adjusted so that the concentration of each element added to the final solution taken for analysis, would be equivalent to 10 μg/L. Deionized, distilled water was used for the preparation of all method reference standards and blanks and for all dilutions.

Sample preparation procedures used for all method reference standards, method blanks, and field samples (both QC and non-QC) are outlined below.

Metals to be Determined	Procedure
Ag, Cd, Cr, Cu, Ni, Pb, Ti	$\underset{\text{Sample}}{100\text{ mL}} + \underset{\text{(+ spiking solution)}}{3\text{ mL con. }HNO_3} + 5\text{ mL }30\%\ H_2O_2 \xrightarrow[\text{to} <50\text{ mL}]{\text{Heat}} 100\text{ mL}$

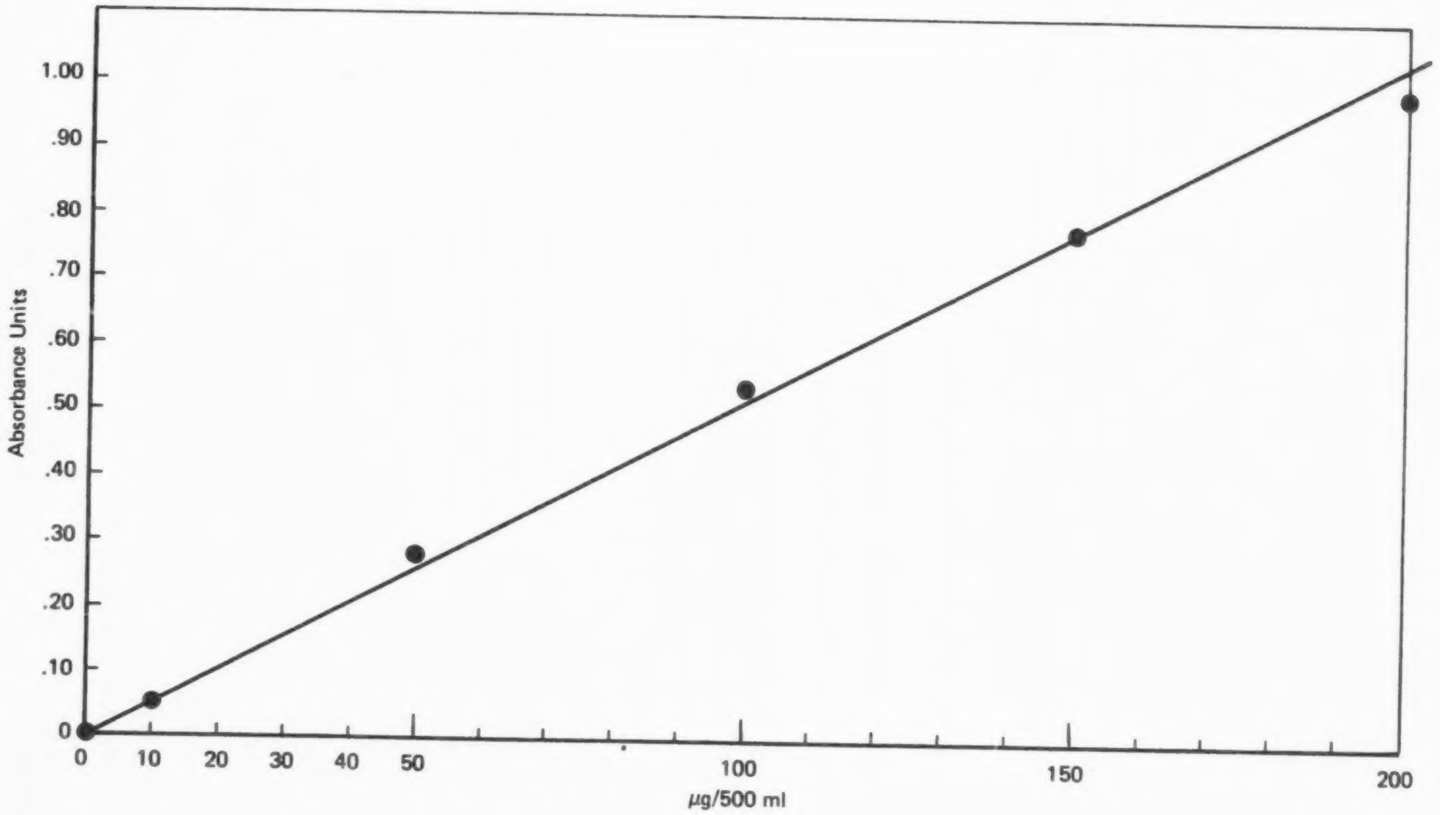

FIGURE C-9. TOTAL CYANIDE CALIBRATION CURVE

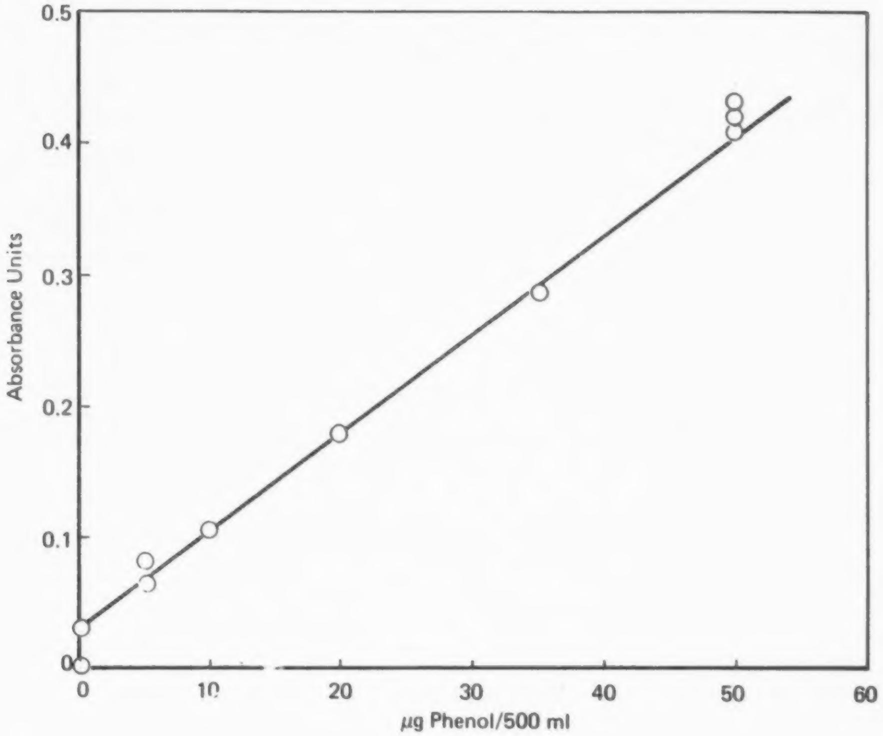

FIGURE C-10. **TOTAL PHENOL CALIBRATION CURVE**

Metals to be Determined	Procedure
Be, Mn, Sb, Zn	100 mL sample + 3 mL con. HNO_3 (+ spiking solution) $\xrightarrow[\text{to dryness}]{\text{Heat}}$
	residue + 3 mL con. HNO_3 $\xrightarrow[\text{reflux to dryness}]{\text{heat}}$
	residue + 10 mL 1:1 HCl $\longrightarrow$ 100 mL
As, Se	100 mL sample + 3 mL con. HNO_3 + 5 mL 30% H_2O_2 (+ spiking solution) $\xrightarrow[\text{to } < 50 \text{ mL}]{\text{heat}}$
	50 mL; 5 mL aliquot + 1 mL 10% $NiNO_3$ $\longrightarrow$ 10 mL
Hg	Protocol, p. 124.

Analysis. Atomic absorption spectroscopy was used for all analyses. For those elements for which either flame AA or flameless AA was to be used depending on the concentration relative to the values specified on p. 45 of the protocol, flameless AA was used for samples containing up to 5x those levels by making appropriate volumetric dilutions. For samples containing in excess of 5x those levels, flame AA was used. The AA technique and instrumentation used for the determination of each metal in the Cincinnati POTW samples are listed in the following table:

Metal	AA Technique	Instrumentation
Hg	Cold Vapor	Perkin-Elmer 303 Atomic Absorption Spectrophotometer, Hg Cold Vapor Apparatus.
Mn, Zn	Flame AA	Perkin-Elmer 503 Atomic Absorption Spectrophotometer, Air-acetylene flame, single slot burner, D_2 Background Corrector.
Ag, As, Be, Cd, Cr, Cu, Ni, Pb, Sb, Se, Tl	Flameless AA	Perkin-Elmer 503 Atomic Absorption Spectrophotometer, HGA 2100 Graphite Furnace, D_2 Background Corrector.

Manufacturer's recommendations were followed for all instrument settings.

Every flameless AA absorbance value taken as representative of the actual concentration in a given sample for the purpose of calculation was an arithmetic mean of a minimum of three absorbance readings corresponding to three separate injections and subsequent analyses of aliquots of that sample.

Samples were divided into groups of no more than 10 samples/group according to source (e.g., Kirkridge) or sample type (e.g., method reference standards.) One sample from each group was analyzed using the method of standard additions. In addition to the neat sample, a minimum of 3 standard additions, each having a different concentration, were run. Additions were made by injection of aliquots of standard solutions directly into the graphite tube containing identical volumes of sample. The concentrations of successive additions were chosen so that the resulting four concentrations and respective absorbance values were all within the linear response range for the element under consideration. The resulting data on a sample analyzed using the method of standard additions was used as a calibration line from which the concentrations of all other samples in the same group were determined.

Detection limits. Reported method detection limits were calculated according to the following equation:

$$\text{Method detection limit} = \sigma \times .675$$

$$\text{where } \sigma = \sqrt{\frac{\Sigma \left(C_{\text{spike}} - \overline{C}_{\text{spike}} \right)^2}{n-1}}$$

$$\text{and } C_{\text{spike}} = \left(\begin{array}{l} \text{concentration in } \mu\text{g/L} \\ \text{of spiked unknown} \end{array} - \begin{array}{l} \text{concentration in} \\ \mu\text{g/L of unknown} \end{array} \right);$$

Theoretical value = 10 µg/L for all elements.

$$\overline{C}_{\text{spike}} = \frac{\Sigma\, C_{\text{spike}}}{n}$$

n = number of spiked unknown samples analyzed (= 20 for first trip)

.675 = statistical factor; ± .675 σ includes 50% of n values of C_{spike} for each element.

Table C-11 lists the reporting limits for the metals.

TABLE C-11

METALS - REPORTING LIMITS

Trips I and II

Metal	Method Reference Standards	Raw Waste-Water Samples
Antimony	3	3
Arsenic	3	4
Beryllium	1	3
Cadmium	2	3
Chromium	12	27
Copper	11	9
Lead	6	6
Manganese	6	11
Mercury	1	1
Nickel	6	9
Selenium	1	2
Silver	1	1
Thallium	1	1
Zinc	2	12

APPENDIX D

Quality Assurance/Quality Control Details

The basic protocol used for the quality control program was that described in the EMSL/EPA March 1978 recommendation.(3) Because of the limited availability of that document, the section pertaining to the intralaboratory quality control is attached as the last part of this Appendix. The adaptations used in this program were discussed in Section VII. A listing of terms and calculations is given in Table D-1. A sample data log and calculation sheet is reproduced in Table D-2. The alternate form for metals is shown in Table D-3. The summary reporting form is shown in Table D-4.

The following is a description of the data listed in the summary reporting form:

DATE: The data the analytical finish was performed.

SAMPLE NO.: The sample number was a unique laboratory code assigned to a composite sample.

CLEAN WATER:

BLK F: The sample was the method blank ("clean" water). The measured or observed concentration value was reported.

METHOD REF. STD. D: This sample was "clean" water spiked with the priority pollutant to a known concentration value.

Oi: The reported concentration value measured or observed for the priority pollutant.

Ti: The true or theoretical concentration value of the priority pollutant spiked into the "clean" water sample.

Pi,%: The percentage recovery for each priority pollutant in each sample (Oi ÷ Ti x 100).

TABLE D-1

EXPLANATION OF SYMBOLS AND CALCULATIONS OF DATA

Symbols used on the data sheets are defined below:

A = Raw wastewater, spiked

B = Raw wastewater, spiked as replicate of A

C = Unknown = raw wastewater, unspiked

D = Method reference standards
= Milli-Q water, spiked at same level as A and B

F = Method blank
= Milli-Q water, unspiked

O_i = Observed value, µg/L

T_i = True (theoretical) value, µg/L

X_i = Observed value, µg/L − unknown value, µg/L

$P_i (\%) = \frac{100\ (O_i)}{T_i}$ = Percent Recovery

$\bar{X}_i$ = Mean of replicate spikes A and B, and $\frac{X_i\ (A) + X_i\ (B)}{2}$

R_i = Range of replicate spikes A and B
= $|X_i\ (A) - X_i\ (B)|$

n = Number of data points

n* = Number of paired samples

C = Spike concentration, µg/L

R_c = Critical range for a specific concentration, = $3.27\ (\bar{R})\ \frac{\sum_{i=1}^{n}}{n}$ $\sum_{i=1} X_i$

$\bar{P}$ = Mean Percent Recovery = $\frac{\sum_{i=1}^{n} P_i}{n}$

S_p = Standard deviation of percentage recovery

$$= \sqrt{\frac{\sum_{i=1}^{n} (P_i - \bar{P})^2}{n - 1}}$$

$\%S_p$ = Relative standard deviation of percentage recovery

$$= \frac{100\ (S_p)}{\bar{P}}$$

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TABLE D-1 (continued)

EXPLANATION OF SYMBOLS AND CALCULATIONS OF DATA FOR METALS

Raw Wastewater Spikes

n = number of duplicate sets

$\bar{\bar{X}}$ = the mean of the duplicate mean measured values

= $\sum_{i=1}^{n} \bar{X} / n$

$S_p(\bar{\bar{X}})$ = Standard deviation of $\bar{\bar{X}}$

$\bar{R}$ = the mean of the calculated ranges (R_i) for the duplicate sets

= $\sum_{i=1}^{n} R_i/n$

$S_p(\bar{R})$ = the standard deviation of $\bar{R}$

RP,% = range percentage of the mean measured value ($\bar{X}$)

= $R_i/X \times 100$

$\overline{RP}$ = the mean of RPs

= $\bar{R}/\bar{\bar{X}} \times 100$

Method Reference Standards

n^* = number of samples

$\bar{P}$ = mean percentage recovery

S_p = the standard deviation of $\bar{P}$

% S_p = the relative standard deviation

TABLE D-2

CALCULATION SHEET

Method:
Compound:
Analyst:

DATE	SAMPLE NUMBER	BLK	METHOD REF. STD.			UNK.	SPIKE			DUPLICATE SPIKE			SPIKE-REPLICATE CALCULATIONS	
			measured value, ppb	true value ppb	Pi %	measured value, ppb	measured value, ppb	true value ppb	Pi %	measured value, ppb	true value ppb	Pi %	$\overline{X}$	Ri

Method Reference Standard Calculations based on 15 QC samples.

$\overline{P}$	σ

Spike Calculations based on 15 QC Samples.

Rc	$\overline{P}$	σ

TABLE D-3

ALTERNATIVE CALCULATION SHEET - METALS

Method:
Compound:
Analyst:

DATE	SAMPLE NUMBER	BLK	METHOD REF. STD.			UNK.	SPIKE			DUPLICATE SPIKE			SPIKE-REPLICATE CALCULATIONS		
			measured value, ppb	true value ppb	Pi %	measured value, ppb	measured value, ppb	true value ppb	Pi %	measured value, ppb	true value ppb	Pi %	$\bar{X}$	Ri	RP,%*

Method Reference Standard Calculations based on 15 QC samples.

Spike Calculations based on 15 QC Samples.

n	$\bar{P}$	Sp	%Sp	n*	$\bar{\bar{X}}$	SP($\bar{X}$)	$\bar{R}$	SP($\bar{R}$)	$\overline{RP}$

TABLE D-4
QUALITY ASSURANCE SUMMARY DATA SHEET

Compound: | Reporting Limit:

Method: | Analyst:

Note: All values are in μg/L unless otherwise specified.

DATE	SAMPLE NO.	BLK. F	METHOD REF. STD.D			UNK. C	SPIKE A			SPIKE B			Spike Mean	Spike Range
			O_i	T_i	P_i,%	O_i	X_i	T_i	P_i,%	X_i	T_i	P_i,%	$\overline{X}_i$	R_i

Method Reference Standard Calculations

n	$\overline{P}$	S_p	$\%S_p$

Replicate Spike Calculations

n	C	R_c

n	$\overline{P}$	S_p	$\%S_p$

METHOD REFERENCE STANDARD CALCULATIONS

After 15 (n) QC samples had been analyzed, the mean percent recovery ($\bar{P}$) and its standard deviation (Sp) and relative standard deviation (%Sp) were calculated.

RAW WASTEWATER (RWW)

UNK.C.: Unspiked raw waterwater aliquot.

Oi: The reported concentration value measured or observed for unknown, C.

SPIKE A:
SPIKE B: Duplicate raw wastewater aliquots spiked with the priority pollutants to a known concentration value.

Xi: The reported concentration value measured or observed for the raw wastewater sample aliquots, from which the observed or measured unknown C value (UNK.C., Oi) has been subtracted.

Ti: The true or theoretical concentration value of the priority pollutant spiked into the raw wastewater sample aliquot.

Pi%: The percentage recovery for each priority pollutant in each sample ($Xi \div Ti \times 100$).

Spike Mean $\bar{X}i$: The mean measured or observed value for the sample's pair of replicate spikes $\frac{Xi(A) + Xi(B)}{2}$

Spike Range Ri: The absolute difference between the measured or observed values for the sample's pair of replicate spikes $Xi(A) - Xi(B)$.

REPLICATE SPIKE CALCULATIONS

After fifteen pairs (n) of raw wastewater QC samples (A, B, and C) were analyzed, the precision was calculated. The EPA QA protocol$^{(3)}$ computed a critical range value (Rc) using the true or theoretical concentration value (C) of the priority pollutant spiked in, and an empirically derived constant (3.27), ($Rc = 3.27 \times C \times \Sigma Ri/\Sigma \bar{X}i$). The constant 3.27

establishes the confidence limit at 95%. The mean percent recovery ($\bar{P}$) and its standard deviation ($\underline{Sp}$) and relative standard deviation ($\%\underline{Sp}$) were calculated for the 30 ($\underline{n}$) raw wastewater spikes.

An alternative procedure (6) was used for calculating the metals statistical data, since an erroneous indication of precision was developed using the EPA protocol.(3) The erroneous precision values for the metals were apparently due to:

1) Spiking the metals near or below the detection limits. The spike concentration levels were decided on by EPA, before data was available on the samples.
2) Several Unk. RWW results were significantly higher than the spiking concentration levels, i.e., As, Cr, Cu, Mn, Pb and Zn data were especially affected.

Using the EPA protocol, the range of the indicated precision for the samples collected from the Cincinnati POTW were Rc = -1040 to Rc = +194. The alternative procedure(6) used the actual measured raw wastewater spike results to calculate a more realistic indication of the precision of the analyses. In this alternative procedure the unknown measured values have not been subtracted from the RWW measured values. A mean range percentage value ($\overline{RP}$) was used to evaluate the precision. This number was calculated as follows: $\overline{RP} = \frac{\overline{Ri}}{\bar{\bar{X}}}$ where $\overline{Ri}$ is the mean of the ranges for fifteen ($\bar{n}^*$) duplicate raw wastewater spiked samples; $\bar{\bar{X}}$ is the mean of the mean measured values from the duplicate samples.

QC data for the individual pollutants is tabulated by analytical category in Tables D-5 through D-11.

TABLE D-5

QUALITY CONTROL

VOLATILES DATA

	METHOD REFERENCE				RAW WASTEWATER						
COMPOUND	n	$\overline{P}$	Sp	%Sp	n	C	Rc	n	$\overline{P}$	Sp	%Sp
Bromochloromethane, IS											
Chloromethane											
Bromomethane											
Vinyl chloride											
Chloroethane	13	38	25	65	9	20	59	18	22	38	173
Methylene chloride	15	69	61	89	15	20	100	30	51	13	256
Acrolein	15	68	32	46	15	100	189	30	24	29	122
Acrylonitrile	15	91	27	30	15	100	65	30	98	24	24
Dichlorodifluoromethane											
Trichlorofluoromethane	15	39	24	62	15	20	22	30	42	35	85
1,1-Dichloroethylene	15	60	32	53	15	20	21	30	59	39	66
Trans-1,2-dichloroethylene	15	90	35	39	15	20	16	30	82	50	62
1,1-Dichloroethane	15	70	8	12	15	20	18	30	67	29	43
Chloroform	15	85	26	31	15	20	21	30	72	27	38
1,2-Dichloroethane	15	108	14	13	15	20	21	30	93	33	35
1,1,1-Trichloroethane	15	89	29	33	15	20	22	30	83	31	37
1,1,2-Trichloroethane	15	109	10	9	15	20	4	30	101	12	12
Carbon tetrachloride	15	93	36	39	15	20	21	30	78	34	44
Bromodichloromethane	15	98	9	10	15	20	12	30	90	22	24

TABLE D-5 (continued)

QUALITY CONTROL

VOLATILES DATA (Cont'd)

COMPOUND	METHOD REFERENCE				RAW WASTEWATER						
	n	$\overline{P}$	Sp	%Sp	n	C	Rc	n	$\overline{P}$	Sp	%Sp
Dibromochloromethane	15	94	11	12	15	20	8	30	85	15	18
Bis-chloromethyl ether											
1,2-Dichloropropane	15	100	34	34	15	20	14	30	99	37	38
Chlorobenzene	15	98	31	31	15	20	6	30	111	32	29
Trans-1,3-dichloropropene	15	89	10	12	15	20	10	30	82	9	11
Cis-1,3-dichloropropene	15	91	13	15	15	20	6	30	84	17	20
Trichloroethylene	15	118	16	14	15	20	10	30	119	19	16
Benzene	15	88	7	8	15	20	5	30	90	11	12
Chloroethyl vinyl ether											
Ethyl benzene	15	122	21	17	15	20	11	30	122	32	26
2-Bromo-1-chloropropane,IS											
Bromoform	15	82	11	13	15	20	6	30	70	11	16
1,1,2,2-Tetrachloroethene	15	102	14	14	15	20	8	30	101	23	22
1,1,2,2-Tetrachloroethane	15	77	42	54	15	20	11	30	59	44	76
1,4-Dichlorobutane,IS											
Toluene	15	99	31	31	15	20	17	30	96	31	33

TABLE D-6

QUALITY CONTROL

ACIDS DATA

COMPOUND	METHOD REFERENCE				RAW WASTEWATER						
	n	$\overline{P}$	Sp	%Sp	n	C	Rc	n	$\overline{P}$	Sp	%Sp
D_{10}-anthracene, IS											
2-Chlorophenol	15	86	29	33	15	50	21	30	93	29	32
2-Nitrophenol	15	105	20	19	15	50	15	30	110	22	20
Phenol	15	77	12	15	15	50	24	30	62	26	42
2,4-Dimethylphenol	15	80	18	23	15	50	19	30	93	17	19
2,4-Dichlorophenol	15	93	30	32	15	50	19	30	108	19	18
2,4,6-Trichlorophenol	15	98	21	22	15	50	16	30	108	16	16
4-Chloro-3-cresol	15	114	13	11	9	50	9	18	124	12	10
2,4-Dinitrophenol	15	94	24	26	15	50	7	30	107	26	24
4,6-Dinitro-2-cresol	15	92	42	45	15	50	10	30	110	26	23
Pentachlorophenol	15	88	32	36	15	50	12	30	114	11	9
4-Nitrophenol	15	56	48	85	15	50	9	30	21	42	206

TABLE D-7

QUALITY CONTROL

BASE/NEUTRALS DATA

COMPOUND	METHOD REFERENCE n	$\overline{P}$	Sp	%Sp	RAW WASTEWATER n	C	Rc	n	$\overline{P}$	Sp	%Sp
D10 Anthracene, IS											
1,3-Dichlorobenzene											
1,4-Dichlorobenzene	15	74	23	31	15	150	54	30	81	19	23
1,2-Dichlorobenzene											
Hexachloroethane	15	66	25	38	15	50	19	30	71	22	30
Bis(2-Chloroisopropyl) ether											
Bis(Chloromethyl) ether											
Bis(2-Chloroethyl) ether	15	72	29	40	15	50	27	30	79	28	36
Nitrobenzene	15	71	26	37	15	50	20	30	76	22	29
Hexachlorobutadiene	15	83	23	27	15	50	22	30	69	16	23
Nitroso Di-n-propylamine	15	63	10	17	15	50	29	30	72	17	24
1,2,4-Trichlorobenzene	15	79	21	27	15	50	20	30	81	16	20
Naphthalene	15	78	16	20	15	51	26	30	86	18	20
Hexachlorocyclopentadiene											
Bis(2-Chloroethoxy)Methane											
Isophorone	15	80	23	29	15	50	24	30	85	26	30

TABLE D-7 (continued)

QUALITY CONTROL

BASE/NEUTRALS DATA (continued)

COMPOUND	METHOD REFERENCE				RAW WASTEWATER						
	n	$\overline{P}$	Sp	%Sp	n	C	Rc	n	$\overline{P}$	Sp	%Sp
2-Chloronaphthalene	15	104	21	20	15	53	16	30	105	19	18
Acenaphthylene	15	102	20	19	15	49	18	30	109	23	21
Acenaphthene	15	109	19	17	15	46	12	30	103	18	18
Dimethyl phthalate	15	71	44	62	15	50	38	30	91	36	40
4-Chlorophenyl phenyl ether											
Fluorene	15	124	26	21	15	52.5	14	30	107	22	21
2,6-Dinitrotoluene	15	132	25	19	15	51.5	13	30	132	33	25
2,4-Dinitrotoluene	15	128	45	35	15	51	40	30	96	41	43
1,2-Diphenyl Hydrazine	15	108	30	28	15	51	21	30	96	27	28
Diethyl phthalate	15	118	39	33	15	50	34	30	108	28	26
Di-n-Butyl phthalate	15	128	46	36	15	50	31	30	67	28	41
Butylbenzyl phthalate											
Bis(2-Ethylhexyl) phthalate	15	80	53	66	15	50	79	30	37	31	84
N-Nitrosodiphenylamine											
Hexachlorobenzene	15	135	54	40	15	49.5	22	30	92	40	43
4-Bromophenyl phenyl ether											

TABLE D-7 (continued)

QUALITY CONTROL

BASE/NEUTRALS DATA (continued)

COMPOUND	METHOD REFERENCE				RAW WASTEWATER						
	n	$\overline{P}$	Sp	%Sp	n	C	Rc	n	$\overline{P}$	Sp	%Sp
Phenanthrene Anthracene	15	125	26	20	15	100	26	30	93	21	22
Fluoranthene	15	154	42	27	15	26	12	30	80	28	35
Pyrene	15	157	48	31	15	24	13	30	86	30	35
Benzidine	15	43	32	74	15	50	48	30	37	41	111
Chrysene Benzo[a]Anthracene	15	117	51	44	15	24	18	30	63	19	30
3,3'-Dichlorobenzidine											
Benzo[b]fluoranthene											
Benzo[k]fluoranthene											
Benzo[a]pyrene	15	89	46	52	15	24	21	30	59	20	34
Indeno(1,2,3-cd)pyrene											
Dibenzo[a,h]anthracene	15	74	42	56	15	25	38	30	57	34	60
Benzo[g,h,i]perylene	15	75	48	64	15	23	30	30	53	39	73
2,3,7,8-TCDD											

TABLE D-8

QUALITY CONTROL

PESTICIDES DATA

COMPOUND	METHOD REFERENCE				RAW WASTEWATER						
	n	$\overline{P}$	Sp	%Sp	n	C	Rc	n	$\overline{P}$	Sp	%Sp
αBHC	15	83	6	8	15	28	11	30	79	10	13
γBHC	15	82	8	9	15	30	10	30	77	9	12
HEPTACHLOR	15	76	7	10	15	34	16	30	71	13	18
β-BHC	15	79	22	28	15	32	13	30	67	28	43
δ-BHC	15	77	9	11	15	30	21	30	70	19	27
ALDRIN	15	74	7	10	15	33	10	30	70	10	14
HEPTACHLOR EPOXIDE	15	82	6	7	15	29	10	30	76	10	14
ENDOSULFAN I.	15	57	11	20	15	31	7	30	62	19	31
DDE	15	70	14	20	15	28	17	30	69	18	26
DIELDRIN	15	66	8	12	15	32	10	30	63	14	22
ENDRIN	15	56	15	26	15	30	24	30	54	14	25
DDD/ENDOSULFAN II	15	73	11	16	15	62	24	30	66	10	15
DDT	15	72	15	21	15	30	21	30	70	15	22

TABLE D-9

QUALITY CONTROL

TOTAL PHENOLS AND TOTAL CYANIDES DATA

METHOD REFERENCE				RAW WASTEWATER						
				Total Phenols						
n	$\bar{P}$	S_p	$\%S_p$	n	C	R_c	n	$\bar{P}$	S_p	$\%S_p$
15	107	13	12	30	60	27	30	93	15	17
				Total Cyanides						
15	103	6	6	15	20	4	30	101	12	12

TABLE D-10

QUALITY CONTROL

METALS DATA (EPA Procedure)

Metal	Method Reference Standards				Raw Wastewater Spikes						
	n	$\overline{P}$	Sp	%Sp	n	C	R_c	n	$\overline{P}$	S_p	$\%S_p$
Antimony	15	61	47	77	15	10	15	30	90	67	74
Arsenic	15	158	29	18	15	10	10	30	110	73	67
Beryllium	15	85	15	17	15	10	9	30	90	38	42
Cadmium	15	83	21	26	15	10	9	30	87	44	51
Chromium	15	129	189	147	15	10	22	30	182	425	234
Copper	15	207	177	85	15	10	39	30	83	323	389
Lead	15	165	152	92	15	10	43	30	67	95	142
Manganese	15	143	98	69	15	10	14	30	185	143	77
Mercury	15	59	31	53	15	10	21	30	42	40	95
Nickel	15	74	96	130	15	10	-1040	30	-22	436	-1982
Selenium	15	135	17	12	15	10	6	30	121	47	39
Silver	15	108	30	27	15	10	3	30	90	21	23
Thallium	15	99	33	33	15	10	2	30	90	29	32
Zinc	15	254	344	135	15	10	94	30	92	554	602

TABLE D-11

QUALITY CONTROL

METALS DATA (Alternative Procedure)

Metal	Method Reference Standards				Raw Wastewater Spikes			
	n	$\overline{P}$	S_p	$\%S_p$	n	$\overline{\overline{X}}$	$\overline{R}$	RP,%
Antimony	15	61	47	77	15	11	4	36
Arsenic	15	158	29	18	15	28	3	11
Beryllium	15	85	15	17	15	10	0.7	7
Cadmium	15	83	21	26	15	10	2	20
Chromium	15	129	189	147	10	126	13	10
Copper	15	207	177	85	15	87	10	11
Lead	15	165	152	92	15	31	9	29
Manganese	15	143	98	69	15	188	8	4
Mercury	15	59	31	53	8	8	1	12
Nickel	15	74	96	130	8	50	30	60
Selenium	15	135	17	12	15	15	2	13
Silver	15	108	30	27	15	11	0.7	6
Thallium	15	99	33	33	15	9	0.6	7
Zinc	15	254	344	135	15	218	25	11

(COPY OF EPA RECOMMENDATION)

QUALITY ASSURANCE PROGRAM FOR THE ANALYSES OF CHEMICAL CONSTITUENTS IN ENVIRONMENTAL SAMPLES*

The following program of quality assurance is for use by laboratories engaged in the analysis of organic and inorganic chemicals, metals, and general analysis parameters in environmental samples.

Each laboratory is responsible for maintaining a continuing record of the data from all quality control checks and for using these data to make decisions on the acceptability of the analytical results as they are acquired. All quality control data generated, problems identified, and corrective actions taken to resolve the problems are to be recorded and provided to the responsible authority when reporting the analytical results. As available, quality control (QC) check samples of known value and performance evaluation (PE) samples should be analyzed by the laboratory prior to initiation of the analytical program.

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*U. S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, March, 1978

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A. Intralaboratory Quality Control

As a part of its intralaboratory analytical quality control program, the laboratory must develop single laboratory precision and accuracy criteria for each parameter that it is required to measure. These criteria must compare favorably with published data. Initially, these data may be applied over a broad concentration range. As more data accumulate, the precision and accuracy of the method should be updated and criteria developed for multiple narrower ranges.

1. **Precision** - To determine the precision of the method, a regular program of analyses of replicate aliquots of environmental samples must be carried out. The precision criterion should be developed from 15 sets of replicate results accumulated over a period of time during the routine analysis program. At least two replicate aliquots of a well mixed sample must be analyzed with each set of 20 samples or less analyzed at a given time. These replicate data must be obtained for each parameter of interest.

Initially, samples selected for replicate analyses should be those that are most representative of the interference potential of the sample type. For example, in the current Effluent Guidelines Verification Program, the influent to the treatment process would be appropriate. As the program progresses, samples representing the entire range of concentrations and interference potential should be designed into the replicate analyses program.

After 15 replicate results have been obtained, calculate the range (R_i) of these results as follows:

$$R_i = | X_{i1} - X_{i2} |$$

where R_i is the difference between the results of the pair (X_{i1} and X_{i2}) from sample i=1 through n. The concentration of each sample is represented by the mean:

$$\bar{X}_i = \frac{(X_{i1} + X_{i2})}{2}$$

where $\bar{X}_i$ is the average of the results of the replicate pair. A preliminary estimate of the critical difference (R_c) between replicate analyses for any specific concentration level (C) can be calculated as:

$$R_c = 3.27 \left(C \sum_{i=1}^{n} R_i\right) / \left(\sum_{i=1}^{n} \bar{X}_i\right).$$

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From these data develop a table of such R_c values for various C values that span the concentration range of interest.

These preliminary critical difference values may be used to judge the acceptability of the succeeding replicate results. To do this, calculate the mean ($\overline{X}$) and difference (R) between the replicate results. Referring to the table of critical range values developed above, find the C nearest to $\overline{X}$ and use its R_c to evaluate the acceptability of R. If the R is greater than R_c, the system precision is out of control and the source of this unusual variability should be identified and resolved before continuing with routine analyses. Record the results of all replicate analyses and periodically (after 25 to 30 additional pairs of replicate results are obtained) revise, update, and improve the table of critical range values.

2. Accuracy - In addition to the initial determination of the precision of the method, a program must be maintained to verify that the laboratory accuracy continues under control. This program is concurrent to the spiked

sample analysis program outlined below and is carried out by preparing check standards and analyzing them according to the method. The check standards should be approximately equal to the concentration found in routine samples. Alternately, one standard above and one standard below the midpoint of the range of the method should be used. Analyze the standard and calculate O_i (the observed value). The percent recovery (P_i) is then calculated as follows:

$$P_i = \frac{100\,(O_i)}{T_i}$$

where T_i = the true value.

After determining the P_i for approximately 15 check standards, calculate the mean ($\overline{P}$) and standard deviation (S_p) of the percentages as follows:

$$\overline{P} = \frac{\sum\limits_{i=1}^{n} P_i}{n}$$

and:

$$S_p = \sqrt{\frac{1}{n-1}\left[\sum_{i=1}^{n} P_i^2 - \left(\sum_{i=1}^{n} P\right)^2 / n\right]}$$

where n = the number of results available.

If the percent recovery for succeeding check standards is not within the interval of $\overline{P} \pm 2\ S_p$, the system should be checked for problems. If problems exist, they must be resolved before continuing with routine analysis. This criteria is tighter than the generally accepted $\overline{P} \pm 3\ S_p$ but will result in more accurate data for real samples if these check standards are used to adjust the calibration curve.

At least one check standard must be analyzed along with each set of 20 samples or less that is analyzed at a given time. This check standard data must be obtained for each parameter of interest.

Record the recovery of all check standards and periodically revise, update and improve the accuracy criteria.

3. Recovery - Determine the recovery of the method for the analysis of environmental samples by adding a spike (T_i, true value) sufficient to approximately double the background concentration level ($\overline{X}_i$) of the sample selected earlier for replicate analysis (Section A1). If the original concentration is higher than the midpoint of the standard curve (range of the method), then the concentration of the spike should be approximately one-half the original concentration. If the concentration of the

original sample was not detectable, the concentration of the spike should be five to fifteen times the lower limit of detection. The volume of standard added in aqueous solution should not dilute the sample by more than ten percent. The volume of standard added in an organic solvent solution should be kept small (100 µl/l or less), so that the solubility of the standard in the water will not be affected.

Analyze the sample, calculate the observed value (O_i), and then calculate the recovery for the spike as follows:

$$P_i = 100(O_i - \overline{X}_i)/T_i$$

where P_i is the percent recovery. If the sample was diluted due to the addition of the spike, adjust $\overline{X}_i$ accordingly.

After determining P_i for at least 15 spike results, calculate the mean percent recovery ($\overline{P}$) and standard deviation (S_p) of the recovery as follows:

$$\overline{P} = (\sum_{i=1}^{n} P_i)/n$$

$$S_p = \sqrt{\frac{1}{n-1}\left[\sum_{i=1}^{n} P_i^{2} - (\sum_{i=2}^{n} P_i)^2/n\right]}$$

where n = the number of percent recovery values available.

If the percent recovery of the spike is not within the interval of $\overline{P} \pm 3\ S_p$, the system accuracy is out of control and the source of this systematic error should be identified and resolved before continuing with routine analysis.

At least one spiked sample must be analyzed along with each set of 20 samples or less that is analyzed at a given time. This spiked data must be obtained for each parameter of interest. Record the recovery data of all spiked analyses and periodically (every 25 to 30 data points) revise, update, and improve the accuracy criteria.

APPENDIX E

Raw Data from Cincinnati Trips

This Appendix contains all of the raw data collected in connection with both trips to Cincinnati. The data are listed sequentially by sample number. Samples 1-28 plus AS were collected during the first trip. Samples 30-69 were collected during the second trip.

Tables E-1 and E-2 give a description of the sample according to location and sample collection data. The "Sample Description" tables give the collection period data and flow data during the sampling period. The site and sampling codes are defined below:

Site Identification:

INF = POTW Influent
E = Elco
GPS = West Bourne
DSC = Del Fair
CD = Sylved
TAP = Tap Water
SGH = St. George
KRA = Kirkridge
PAS = POTW Influent Autosampler
ASD = Del Fair Autosampler

Sample Identification

FB = Field Blank
AS = Autosampler
QC = Quality Control

Samples for the classical parameters analyses for Nos. 1-28 were delayed eight days due to an airfreight shipment problem. Accordingly, the values from these samples may be in error. Several samples were lost for this analysis set due to shipping breakage.

The chemical analyses have been tabulated by sample number and grouped according to the following categories of analysis:

Purgeables (VOA)

Acids

Base/Neutrals/Pesticides

Metals

Total Cyanides and Total Phenols

Classical Wastewater Parameters

All analyses were as described in Section VI and Appendix C.

TABLE E-1

COMPOSITED SAMPLE DESCRIPTORS

Cincinnati Trip I

Location/Compositing Period	Sample Numbers		
	8/8	8/9	8/10
Kirkridge/24 hour	1 (QC)	10 (QC)	24 (QC)
POTW Influent/24 hour	2 (QC)	11 (QC)	23 (QC)
Tap Water/24 hour	3 (QC)	12 (QC)	
Elco/6 hour	4 (QC)	13 (QC)	22
Elco/18 hour	5	14	21
West Bourne/12 hour	6	15	25
West Bourne/12 hour	7	16	26
Del Fair/12 hour	8	17	27
Del Fair/12 hour	9	18	28
Field Blank/24 hour		19	
Field Blank/24 hour		20	
POTW Autosampler		AS	

TABLE E-2

COMPOSITED SAMPLE DESCRIPTORS

Cincinnati Trip II

Location/Compositing Period	Sample Numbers		
	9/8	9/9	9/10
POTW Influent/24 hour	30 (QC)	43 (QC)	56 (QC)
Elco/24 hour	31 (QC)	44 (QC)	57 (QC)
West Bourne/12 hour	32 (QC)	45 (QC)	58 (QC)
West Bourne/12 hour	33	46	59
Del Fair/12 hour	34	47	60
Del Fair/12 hour	35	48	61
Sylved/12 hour	36	49	62
Sylved/12 hour	37	50	63
Tap Water/24 hour	38	51	--
St. George/24 hour	39	52	--
Kirkridge/24 hour	--	53	64
POTW Influent Autosampler/24 hour	40	54	--
Del Fair Autosampler/24 hour	41	55	--
Field Blank #1/24 hour	42	--	--
Field Blank #2/24 hour	--	--	65
POTW Autosampler Blank	66	68	--
Del Fair Autosampler Blank	67	69	--

SAMPLE DESCRIPTION

SAMPLE NUMBER	1	2	3	4	5	6	7	8	9	10
Site Code	KRA-A	INF-A	TAP-A	E-2-A	E-1-A	GPS-1-A	GPS-2-A	DSC-1-A	DSC-2-A	KRA-B
Sampling Period										
Date	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/8	8/9
Start Time	0800	0700	0900	0100	0700	0900	2100	0800	2000	0800
Hours	24	24	24	6	18	12	12	12	12	24
Flow (Lps)										
Avg.	37.2	8.67 mgd		2.84	25.4	41.8	26.5	104*	74.9*	31.6
Min.	0.9	6.0 mgd		1.89	13.2	32.9	19.7	98	51.5	6.4
Max.	103.7	9.75 mgd		3.79	63.2	57.6	30.7	110	97.3	77.6

SAMPLE NUMBER	11	12	13	14	15	16	17	18	19	20
Site Code	INF-B	TAP	E-2-B	E-1-B	GPS-1-B	GPS-2-B	DSC-1-B	DCS-2-B	FB	FB
Sampling Period										
Date	8/9	8/9	8/9	8/9	8/9	8/9	8/9	8/9	8/9	8/9
Start Time	0700	0900	0100	0700	0900	2100	0800	2000	0700	0800
Hours	24	24	6	18	12	12	12	12	24	24
Flow (Lps)										
Avg.	8.47 mgd		8.14	12.8	45.6	31.0	98.6*	80.4*		
Min.	5.5 mgd		6.43	4.54	36.7	24.6	87.4	58.7		
Max.	9.5 mgd		9.84	25.0	50.3	44.3	105.6	103.3		

* Flow values may be high.

SAMPLE DESCRIPTION

SAMPLE NUMBER	21	22	23	24	25	26	27	28		
Site Code	E-1-C	E-2-C	INF-C	KRA-C	GPS-1-C	GPS-2-C	DSC-1-C	DSC-2-C		
Sampling Period										
Date	8/10	8/10	8/10	8/10	8/10	8/10	8/10	8/10		
Start Time	0700	0100	0700	0800	0900	2100	0800	2000		
Hours	18	6	24	24	12	12	12	12		
Flow (Lps)										
Avg.	11.9	6.8	8.3 mgd	21.7	37.2	21.0	45.8	25.6		
Min.	4.16	6.8	3 mgd	4.5	6.1	6.1	36.7	8.3		
Max.	27.6	6.8	13 mgd	59.8	89.2	42.0	58.7	47.3		

SAMPLE NUMBER										
Site Code										
Sampling Period										
Date										
Start Time										
Hours										
Flow (Lps)										
Avg.										
Min.										
Max.										

SAMPLE DESCRIPTION

SAMPLE NUMBER	30	31	32	33	34	35	36	37	38	39
Site Code	INF-A	E-A	GPS-1-A	GPS-2-A	DSC-1-A	DSC-2-A	CD-1-A	CD-2-A	TAP-A	SGH-A
Sampling Period										
Date	9/8	9/8	9/8	9/8	9/8	8/9	9/8	9/8	9/8	9/8
Start Time	0700	0800	1000	2200	0800	2000	0900	2100	0700	1000
Hours	24	24	12	12	12	12	12	12	24	24
Flow (Lps)	(MED)									
Avg.	9.7	35.4	70.6	47.6	23.9*	25.5*	183.4	93.5		59.2
Min.	6.5	12.7	58.0	33.1	17.7*	11.0*	86.8	30.1		10.1
Max.	10.5	85.8	76.9	61.1	33.6*	35.0*	262.8*	262.8		108.3

SAMPLE NUMBER	40	41	42	43	44	45	46	47	48	49
Site Code	PAS-A	ASD-A	FB-1	INF-B	E-B	GPS-1-B	GPS-2-B	DSC-1-B	DSC-2-B	CD-1-B
Sampling Period										
Date	9/8	9/8	9/8	9/9	9/9	9/9	9/9	9/9	9/9	9/9
Start Time	0700	0800	0900	0700	0800	1000	2200	0800	2000	0900
Hours	24	24	24	24	24	12	12	12	12	12
Flow (Lps)				(MGD)						
Avg.				12.1	38.5	69.8	31.9	31.9*	14.7*	102.8
Min.				8.0	4.8	67.4	18.5	21.1*	6.2*	74.0
Max.				15.0	130.7	73.7	51.8	38.8	20.8	147.5

*Flow values may be high.

SAMPLE DESCRIPTION

SAMPLE NUMBER	50	51	52	53	54	55	56	57	58	59
Site Code	CD-2-B	TAP-B	SGH-B	KRA-B	PAS-B	ASD-B	INF-C	E-C	GPS-1-C	GPS-2-C
Sampling Period										
Date	9/9	9/9	9/9	9/9	9/9	9/9	9/10	9/10	9/10	9/10
Start Time	2100	0700	1000	0900	0700	0800	0700	0800	1000	2200
Hours	12	24	24	24	24	24	24	24	12	12
Flow (Lps)							(MGD)			
Avg.	120.0		28.4	23.0			10.9	23.7	62.3	41.6
Min.	38.4		5.0	5.3			7.5	12.7	56.4	34.4
Max.	216.9		51.8	32.3			12.5	50.5	72.2	51.8

SAMPLE NUMBER	60	61	62	63	64	65	66	67	68	69
Site Code	DSC-1-C	DSC-2-C	CD-1-C	CD-2-C	KRA-C	FB-2	POTW AS-FB	POTW AS-FB	DSC AS-FB	DSC AS-FB
Sampling Period										
Date	9/10	9/10	9/10	9/10	9/10	9/10	9/8	9/8	9/9	9/9
Start Time	0800	2000	0900	2100	0900	0800				
Hours	12	12	12	12	24	24				
Flow (Lps)										
Avg.	30.7	35.8	114.9	73.4	29.6					
Min.	25.6	19.2	39.5	41.7	10.8					
Max.	38.7	65.9	168.2	116.2	98.3					

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)

SAMPLE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Purgeables (VOA)														
Methylene chloride	VOA SAMPLE LOST	62	14	–	–	39	–	–	53	–	24	2	80	14
1,1-Dichloroethylene		–	–	–	–	1	–	–	–	–	–	–	–	–
Chloroform		2	43	1	3	6	5	5	5	2	3	36	1	1
1,2-Dichloroethane		3	–	–	–	–	–	–	–	–	–	–	–	–
1,1,1-Trichloroethane		1	–	–	–	17	4	–	–	–	1	–	–	–
Bromodichloromethane		–	3	–	–	–	–	–	–	–	–	3	–	–
Dibromochloromethane		–	12	–	–	1	2	–	–	–	–	16	–	–
Chlorobenzene		–	–	–	–	–	–	–	–	–	–	–	–	–
Benzene		4	–	–	–	3	–	–	–	–	4	–	–	–
Ethyl Benzene		2	–	1	2	3	3	2	2	1	2	1	2	–
Bromoform		–	–	–	–	–	–	–	–	–	–	1	–	–
1,1,2,2-Tetrachloroethylene		–	–	–	–	2	1	2	–	–	–	–	–	–
1,1,2,2-Tetrachloroethane		–	–	–	–	–	–	–	–	–	–	–	–	–
Toluene		11	–	1	2	9	30	3	3	–	2	–	–	2
Trans-1,2-dichloroethylene		–	–	–	–	–	–	–	–	–	–	–	–	–

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)

SAMPLE NUMBER	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Purgeables (VOA)														
Methylene chloride	-	11	>100	-	-	>100	37	57	>100	-	15	-	45	3
1,1-Dichloroethylene	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloroform	5	4	6	6	-	-	6	-	2	2	3	3	6	4
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-	6	-	-	-
1,1,1-Trichloroethane	6	1	-	-	-	-	1	11	-	-	7	-	-	-
Bromodichloromethane	-	-	2	2	-	-	2	-	-	-	2	1	2	2
Dibromochloromethane	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Chlorobenzene	-	-	-	-	-	-	-	16	-	-	-	-	-	-
Benzene	-	-	-	-	-	-	-	-	4	-	>100	-	-	-
Ethyl Benzene	4	1	3	1	-	2	3	23	2	-	>100	-	18	5
Bromoform	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1,2,2-Tetrachloroethylene	3	-	20	-	-	-	11	16	1	-	5	-	11	-
1,1,2,2-Tetrachloroethane	-	-	-	-	-	-	-	-	5	-	-	-	-	-
Toluene	3	-	4	-	-	-	1	19	-	-	>100	-	32	15
Trans-1,2-dichloroethylene	-	-	1	1	-	-	-	-	-	-	-	-	1	1

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)

SAMPLE NUMBER	30	31	32	33	34	35	36	37	38	39	40	41	42	43
Purgeables (VOA)														
Methylene chloride	–	20	–	–	–	42	–	–	–	–	NO VOA	NO VOA	14	1
1,1-Dichloroethylene	–	–	–	–	–	–	–	–	–	–			–	–
Chloroform	5	2	3	3	8	6	3	2	41	13			4	2
1,2-Dichloroethane	–	–	–	–	–	–	–	–	–	–			–	–
1,1,1-Trichloroethane	–	–	1	–	–	–	–	–	–	–			–	–
Bromodichloromethane	–	–	–	2	2	5	–	–	32	11			–	–
Dibromochloromethane	–	–	–	1	3	3	–	–	16	8			–	–
Chlorobenzene	–	–	–	–	–	–	–	–	–	–			–	–
Benzene	2	–	10	–	1	1	–	–	–	–			–	4
Ethyl Benzene	–	–	8	–	–	–	–	–	–	–			–	–
Bromoform	–	–	–	–	–	–	–	–	3	3			–	–
1,1,2,2-Tetrachloroethylene	–	1	4	3	14	5	3	2	–	–			–	3
1,1,2,2-Tetrachloroethane	–	–	–	–	–	–	–	–	–	–			–	–
Toluene	–	–	51	–	1	1	3	–	–	–			–	–
Trans-1,2-dichloroethylene	–	–	–	–	–	–	–	–	–	–			–	–

PRIORITY POLLUTANT CHEMICAL ANALYSIS ($\mu g/L$)

SAMPLE NUMBER	44	45	46	47	48	49	50	51	52	53	54	55	56	57
Purgeables (VOA)														
Methylene chloride	-	8	-	46	12	24	-	-	-	-	NO VOA	NO VOA	14	-
1,1-Dichloroethylene	-	-	-	-	-	-	-	-	-	-			-	-
Chloroform	3	6	3	7	7	3	2	38	10	2			2	2
1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-			-	-
1,1,1-Trichloroethane	-	1	-	3	10	-	-	-	-	-			-	-
Bromodichloromethane	-	2	2	2	2	-	-	29	8	-			-	-
Dibromochloromethane	-	1	1	3	3	1	-	16	6	-			-	-
Chlorobenzene	-	-	-	-	-	-	-	-	-	-			-	-
Benzene	1	10	-	1	1	-	-	-	2	-			4	-
Ethyl Benzene	-	19	-	-	-	-	-	-	-	-			-	-
Bromoform	-	-	-	-	-	-	-	3	-				-	-
1,1,2,2-Tetrachloroethylene	2	3	2	10	5	5	2	-	1	1			2	-
1,1,2,2-Tetrachloroethane	-	-	-	-	-	-	-	-	-	-			-	3
Toluene	-	81	-	2	4	5	-	-	-	3			-	22
Trans-1,2-dichloroethylene	-	-	-	-	-	-	-	-	-	-			-	-

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)

SAMPLE NUMBER	58	59	60	61	62	63	64	65	66	67	68	69		
Purgeables (VOA)														
Methylene chloride	2	–	–	–	–	–	–	–	ND VOA	ND VOA	ND VOA	ND VOA		
1,1-Dichloroethylene	–	–	–	–	–	–	–	–						
Chloroform	4	4	9	3	2	2	2	1						
1,2-Dichloroethane	–	–	–	–	–	–	–	–						
1,1,1-Trichloroethane	3	–	8	1	–	–	–	–						
Bromodichloromethane	2	2	5	2	–	–	–	–						
Dibromochloromethane	1	2	3	3	–	–	–	–						
Chlorobenzene	–	–	–	–	–	–	–	–						
Benzene	2	1	–	1	–	–	–	–						
Ethyl Benzene	–	–	–	–	–	–	–	–						
Bromoform	–	–	–	–	–	–	–	–						
1,1,2,2-Tetrachloroethylene	5	3	5	3	2	1	1	–						
1,1,2,2-Tetrachloroethane	–	–	–	–	–	–	–	–						
Toluene	2	2	1	1	1	–	–	–						
Trans-1,2-dichloroethylene	–	–	–	–	–	–	–	–						

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)

SAMPLE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Acids														
Phenol	-	-	-	-	20	-	15	-	-	-	-	-	-	20
2,4-Dimethylphenol	-	-	-	-	-	-	-	-	-	-	-	-	-	10
Pentachlorophenol	-	-	-	-	-	-	-	-	-	-	26	-	-	-

SAMPLE NUMBER	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Acids														
Phenol	-	-	17	-	-	-	19	-	-	10	-	-	16	-
2,4-Dimethylphenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pentachlorophenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SAMPLE NUMBER	30	31	32	33	34	35	36	37	38	39	40	41	42	43
Acids														
Phenol	-	21	14	-	-	-	-	-	-	-	-	10	-	-
2,4 Dimethylphenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pentachlorophenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-

PRIORITY POLLUTANT CHEMICAL ANALYSIS (µg/L)

SAMPLE NUMBER	44	45	46	47	48	49	50	51	52	53	54	55	56	57
Acids														
Phenol	35	11	10	16	-	-	-	-	-	-	-	-	-	20
2,4-Dimethylphenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pentachlorophenol	-	-	-	-	-	-	-	-	11	-	-	-	-	-

SAMPLE NUMBER	58	59	60	61	62	63	64	65	66	67	68	69		
Acids														
Phenol	-	-	-	-	-	-	-	-	-	-	-	-		
2,4-Dimethylphenol	-	-	-	-	-	-	-	-	-	-	-	-		
Pentachlorophenol	-	-	-	-	-	-	-	-	-	-	-	-		

SAMPLE NUMBER														
Acids														
Phenol														
2,4-Dimethylphenol														
Pentachlorophenol														

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)

SAMPLE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14
BASE/NEUTRALS/PESTICIDES														
Naphthalene	-	12	-	-	-	-	-	-	-	-	-	-	-	17
Diethyl phthalate	-	13	-	18	-	16	39	-	-	18	-	13	80	-
Di-n-butyl phthalate	-	16	-	-	-	15	22	-	-	-	-	36	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	16	26	27	-	13	22	15	54	-	24
Butyl benzyl phthalate	-	-	-	-	-	-	31	-	-	-	-	-	-	-
Anthracene/Phenanthrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dichlorobenzenes	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SAMPLE NUMBER	15	16	17	18	19	20	21	22	23	24	25	26	27	28
BASE/NEUTRALS/PESTICIDES														
Naphthalene	11	-	-	-	-	-	-	-	14	-	150	-	11	-
Diethyl phthalate	39	18	25	12	-	-	-	38	22	28	38	16	18	15
Di-n-butyl phthalate	28	33	41	18	-	-	10	24	26	17	55	20	16	15
Bis(2-ethylhexyl)phthalate	40	18	20	29	-	-	23	-	-	-	11	-	12	13
Butyl benzyl phthalate	-	16	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene/Phenanthrene	-	-	-	-	-	-	-	-	-	-	15	-	-	-
Dichlorobenzenes	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptachlor	-	-	-	-	-	-	-	-	-	-	-	-	-	-

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)

SAMPLE NUMBER	AS													

BASE/NEUTRALS/PESTICIDES

Naphthalene	–													
Diethyl phthalate	–													
Di-n-butyl phthalate	12													
Bis(2-ethylhexyl)phthalate	–													
Butyl benzyl phthalate	–													
Anthracene/Phenanthrene	–													
Dichlorobenzenes	–													
Heptachlor	–													

SAMPLE NUMBER														

BASE/NEUTRALS/PESTICIDES

Naphthalene														
Diethyl phthalate														
Di-n-butyl phthalate														
Bis(2-ethylhexyl)phthalate														
Butyl benzyl phthalate														
Anthracene/Phenanthrene														
Dichlorobenzenes														
Heptachlor														

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)

SAMPLE NUMBER	30	31	32	33	34	35	36	37	38	39	40	41	42	43
BASE/NEUTRALS/PESTICIDES														
Naphthalene	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Diethyl phthalate	13	86	12	–	36	35	18	19	–	–	12	18	–	21
Di-n-butyl phthalate	–	15	47	–	45	12	–	21	21	83	–	11	–	16
Bis(2-ethylhexyl)phthalate	–	20	22	–	31	–	11	12	12	10	–	26	19	11
Butyl benzyl phthalate	–	25	24	–	15	10	–	–	–	–	–	12	–	–
Anthracene/Phenanthrene	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dichlorobenzenes	–	–	–	–	31	–	34	–	–	–	–	–	–	–
Heptachlor	–	–	–	–	–	–	–	–	–	–	–	–	–	3

SAMPLE NUMBER	44	45	46	47	48	49	50	51	52	53	54	55	56	57
BASE/NEUTRALS/PESTICIDES														
Naphthalene	–	11	–	–	–	–	–	–	–	–	–	–	–	–
Diethyl phthalate	38	23	–	–	–	–	12	–	10	35	–	18	–	12
Di-n-butyl phthalate	–	–	–	–	226	18	–	–	4	–	–	187	17	49
Bis(2-ethylhexyl)phthalate	13	15	12	40	163	12	–	–	47	–	–	36	–	–
Butyl benzyl phthalate	13	–	–	–	188	–	–	–	–	–	–	58	–	–
Anthracene/Phenanthrene	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dichlorobenzenes	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Heptachlor	–	2	–	–	–	–	–	–	–	–	–	–	–	–

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)

SAMPLE NUMBER	58	59	60	61	62	63	64	65	66	67	68	69		
BASE/NEUTRALS/PESTICIDES														
Naphthalene	–	–	–	–	–	–	–	–	–	–	–	–		
Diethyl phthalate	–	–	11	–	–	–	14	–	–	–	–	–		
Di-n-butyl phthalate	–	–	102	48	19	25	77	–	–	–	–	–		
Bis(2-ethylhexyl)phthalate	–	–	14	–	–	–	12	–	–	–	–	–		
Butyl benzyl phthalate	–	–	25	–	–	–	36	–	–	–	–	–		
Anthracene/Phenanthrene	–	–	–	–	–	–	–	–	–	–	–	–		
Dichlorobenzenes	–	–	–	–	–	–	–	–	–	–	–	–		
Heptachlor	1	–	–	–	–	–	–	–	–	–	–	–		

SAMPLE NUMBER														
BASE/NEUTRALS/PESTICIDES														
Naphthalene														
Diethyl phthalate														
Di-n-butyl phthalate														
Bis(2-ethylhexyl)phthalate														
Butyl benzyl phthalate														
Anthracene/Phenanthrene														
Dichlorobenzenes														
Heptachlor														

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)

SAMPLE NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14
METALS	**DETECTION LIMIT**														
Silver	1	–	5	4	–	–	2	3	2	–	2	5	–	–	1
Arsenic	4	21	33	–	–	11	9	7	10	–	30	29	6	5	16
Beryllium	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cadmium	3	–	3	–	–	–	–	6	–	–	–	4	–	–	–
Chromium	27	33	130	40	–	–	–	–	–	–	–	–	–	–	–
Copper	9	110	87	37	43	110	54	29	46	14	80	65	40	110	180
Mercury	1	–	–	–	–	2	–	–	–	–	–	–	–	–	–
Manganese	11	110	380	16	26	63	240	360	570	600	94	350	14	39	340
Nickel	9	–	36	52	16	–	42	–	–	19	–	–	–	43	19
Lead	6	12	22	–	19	47	21	15	8	–	–	18	–	19	60
Antimony	3	–	–	–	23	8	–	–	–	33	–	–	–	–	–
Selenium	2	–	–	–	5	6	–	–	4	2	–	4	3	6	4
Thallium	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Zinc	12	140	530	110	–	160	250	110	130	56	94	350	–	98	120

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)

SAMPLE NUMBER		15	16	17	18	19	20	21	22	23	24	25	26	27	28
METALS	DETECTION LIMIT														
Silver	1	–	5	12	–	–	3	2	–	4	2	2	–	–	–
Arsenic	4	9	10	9	14	–	–	40	14	35	32	15	8	15	13
Beryllium	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cadmium	3	6	6	–	–	–	–	8	–	4	–	6	5	–	–
Chromium	27	–	–	–	–	–	–	–	–	430	–	–	–	–	–
Copper	9	62	75	44	71	16	12	160	120	130	180	87	89	35	48
Mercury	1	–	–	–	–	–	–	–	–	–	–	2	2	–	–
Manganese	11	300	290	470	600	–	23	700	29	410	45	420	370	440	570
Nickel	9	85	12	–	–	12	28	51	–	92	–	–	–	–	41
Lead	6	22	24	–	17	23	–	130	8	49	14	120	11	6	–
Antimony	3	–	–	–	–	–	6	–	–	–	–	–	–	–	–
Selenium	2	–	–	7	2	–	–	–	6	–	–	–	–	–	5
Thallium	1	–	–	–	–	–	–	–	–	–	–	4	–	–	–
Zinc	12	140	130	150	79	62	–	240	62	660	140	250	–	120	190

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)

SAMPLE NUMBER		AS	30	31	32	33	34	35	36	37	38	39	40	41	42
METALS	DETECTION LIMIT														
Silver	1	2	5	–	–	–	–	–	–	–	–	12	5	2	1
Arsenic	4	25	14	8	11	4	6	5	11	11	14	8	11	7	10
Beryllium	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cadmium	3	–	–	–	–	–	–	–	–	–	8	–	8	–	–
Chromium	27	–	250	77	–	–	–	–	–	–	–	–	37	–	–
Copper	9	70	72	87	33	29	38	14	59	29	35	660	20	65	–
Mercury	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Manganese	11	355	310	110	280	390	350	460	350	340	–	17	310	420	–
Nickel	9	22	98	–	56	13	33	–	38	–	–	–	–	–	–
Lead	6	–	18	37	27	29	–	–	8	–	–	20	–	–	–
Antimony	3	–	–	8	–	–	–	–	–	–	–	–	–	–	–
Selenium	2	–	8	2	1	–	10	8	15	14	8	13	10	9	6
Thallium	1	–	–	–	–	1	1	–	–	–	–	–	–	–	–
Zinc	12	350	430	120	140	56	130	58	240	210	18	87	440	110	–

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)

SAMPLE NUMBER		43	44	45	46	47	48	49	50	51	52	53	54	55	56
METALS	DETECTION LIMIT														
Silver	1	2	–	2	–	3	2	17	–	–	18	–	4	–	2
Arsenic	4	14	24	11	6	8	8	11	16	5	–	6	15	8	12
Beryllium	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cadmium	3	4	–	–	–	19	–	4	–	–	–	–	–	–	–
Chromium	27	140	–	–	–	–	–	–	–	–	–	–	24	–	–
Copper	9	33	55	120	19	44	31	51	28	–	810	140	25	38	12
Mercury	1	2	–	–	–	–	–	–	–	–	–	–	–	1	–
Manganese	11	310	56	250	390	330	440	360	380	–	38	73	320	370	320
Nickel	9	27	–	23	17	38	44	14	10	–	–	–	–	68	–
Lead	6	13	22	59	9	–	–	29	–	–	170	–	–	–	–
Antimony	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Selenium	2	11	–	–	10	2	10	10	12	6	9	9	11	10	9
Thallium	1	–	–	1	–	–	2	–	–	–	–	–	–	–	–
Zinc	12	230	110	190	110	180	280	170	84	47	300	120	210	370	150

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)

SAMPLE NUMBER		57	58	59	60	61	62	63	64	65					
METALS	DETECTION LIMIT														
Silver	1	–	–	–	–	–	–	–	–	–					
Arsenic	4	11	–	6	10	10	15	19	8	3					
Beryllium	3	–	–	–	–	–	–	–	–	8					
Cadmium	3	–	–	–	–	–	–	–	–	–					
Chromium	27	23	–	–	–	–	–	–	–	–					
Copper	9	99	51	23	32	17	33	18	210	–					
Mercury	1	–	–	–	–	–	–	–	–	–					
Manganese	11	50	300	360	380	380	380	390	81	11					
Nickel	9	–	19	–	23	–	–	–	–	–					
Lead	6	76	33	5	–	–	7	–	–	7					
Antimony	3	–	–	–	–	–	–	10	–	–					
Selenium	2	25	–	9	9	8	8	8	12	6					
Thallium	1	–	–	–	2	–	–	–	–	–					
Zinc	12	150	130	49	260	86	140	74	160	28					

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)

SAMPLE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Total Cyanides	-	100	-	-	-	-	-	-	-	-	28	-	-	-
Total Phenols	41	27	11	34	64	37	28	40	26	36	13	21	60	86

SAMPLE NUMBER	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Total Cyanides	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phenols	36	29	27	25	16	37	40	47	27	33	43	36	50	52

SAMPLE NUMBER	AS													
Total Cyanides	100													
Total Phenols	-													

SAMPLE NUMBER														
Total Cyanides														
Total Phenols														

PRIORITY POLLUTANT CHEMICAL ANALYSIS (μg/L)

SAMPLE NUMBER	30	31	32	33	34	35	36	37	38	39	40	41	42	43
Total Cyanides	90	–	–	–	–	–	–	–	–	–	–	–	–	–
Total Phenols	30	70	37	30	43	42	41	29	–	72	22	21	–	22

SAMPLE NUMBER	44	45	46	47	48	49	50	51	52	53	54	55	56	57
Total Cyanides	–	–	–	–	–	–	–	–	–	–	–	–	30	–
Total Phenols	32	42	32	50	43	22	24	–	35	–	22	38	29	62

SAMPLE NUMBER	58	59	60	61	62	63	64	65	66	67	68	69		
Total Cyanides	–	–	–	–	–	–	–	–	–	–	–	–		
Total Phenols	38	31	27	19	18	19	30	–	–	–	–	–		

SAMPLE NUMBER														
Total Cyanides														
Total Phenols														

CLASSICAL WASTE WATER PARAMETER ANALYSIS

SAMPLE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14
pH	7.4	7.5	8.0	7.4	8.5	7.5	7.6	7.7	7.6	7.7	7.4	8.0	7.8	9.7
T (°C)	21.8	22.1	24.5	23.2	23.8	25.2	24.7	22.6	22.5	21.9	22.8	25.0	23.5	25.0
Ammonia	23	18	0.25	31	23	16	19	15	13	34	12	0.1	31	13
Oil and Grease	115	Lost	-	170	30	35	35	3340	30	Lost	125	-	1870	Lost
TSS	120	70	-	40	130	100	40	140	110	100	80	-	80	1060
TOC	63	-	5	67	130	76	44	49	64	72	38	3	54	73
COD	150	-	-	140	330	250	170	150	270	375	120	-	140	310
BOD	100	35	-	60	145	90	50	110	90	70	40	-	55	130

CLASSICAL WASTE WATER PARAMETER ANALYSIS

SAMPLE NUMBER	15	16	17	18	19	20	21	22	23	24	25	26	27	28
pH	7.4	7.4	7.6	7.4	-	-	8.8	9.1	7.4	8.2	7.2	8.1	7.5	7.4
T (°C)	25.7	25.0	22.8	23.1	-	-	24.7	22.0	22.3	21.4	25.1	24.2	22.9	22.6
Ammonia	17	18	20	10	-	-	11	27	12	18	15	14	15	16
Oil and Grease	30	1520	45	35	-	-	30	10	115	50	15	Lost	215	50
TSS	90	40	80	70	-	-	1940	40	150	160	250	180	160	180
TOC	64	35	82	66	-	-	61	46	43	64	43	39	89	75
COD	220	160	310	230	-	-	280	120	250	250	140	110	300	250
BOD	105	55	80	80	-	-	90	35	55	125	45	50	125	110

CLASSICAL WASTE WATER PARAMETER ANALYSIS

SAMPLE NUMBER	30	31	32	33	34	35	36	37	38	39	40	41	42	43
pH	6.8	6.4	7.0	7.2	7.2	7.4	7.2	7.6	6.5	7.8	-	-	-	6.1
T (^{o}C)	22.9	22.7	26.0	24.4	25.0	24.6	23.0	23.8	23.9	32.6	-	-	-	22.7
Ammonia	12	21	13	12	17	10	9	8	0.10	0.85	11	13		15
Oil and Grease	20	55	35	25	35	20	20	15	-	15	20	35		25
TSS	40	220	150	70	160	70	100	60	-	30	80	100		110
TOC	48	130	78	72	102	66	76	74	4	32	60	82		56
COD	190	380	320	190	290	155	180	125	-	80	150	265		180
BOD	50	185	110	90	125	55	95	75	-	40	35	80		60

CLASSICAL WASTE WATER PARAMETER ANALYSIS

SAMPLE NUMBER	44	45	46	47	48	49	50	51	52	53	54	55	56	57
pH	6.2	6.9	7.4	7.1	7.6	7.3	7.7	6.3	9.0	6.2	-	-	6.0	6.4
T (°C)	22.5	26.2	24.4	25.2	25.1	22.9	23.1	24.2	31.0	21.2	-	-	22.8	22.8
Ammonia	23	13	14	17	11	11	11	0.10	<5	21	12	13	14	26
Oil and Grease	55	40	55	45	65	25	20	-	20	45	25	55	30	30
TSS	170	230	30	210	100	130	60	5	190	200	130	200	170	40
TOC	105	110	82	118	72	77	56	5	1040	120	96	124	62	120
COD	410	390	215	370	145	230	180	-	2700	340	240	390	190	350
BOD	220	155	95	175	105	70	60	-	1250	145	40	125	50	195

CLASSICAL WASTE WATER PARAMETER ANALYSIS

SAMPLE NUMBER	58	59	60	61	62	63	64								
pH	7.1	7.4	7.4	7.3	7.6	7.2	6.5								
T (^oC)	24.9	24.2	25.7	25.6	22.7	22.4	21.6								
Ammonia	17	13	16	9.3	17	9.8	23								
Oil and Grease	65	20	50	40	30	20	45								
TSS	150	100	150	90	90	70	200								
TOC	104	63	116	74	80	53	140								
COD	330	150	295	210	180	200	300								
BOD	150	55	100	100	55	55	165								

APPENDIX F

Analytical Data by Site Location

Appendix F contains the analytical data tabulated by site location. These tables include data for all of the organics which were found in at least one location, as well as data for the metals, total cyanides, total phenols, and classical wastewater parameters. Details on the sampling locations and chemical analyses can be found in Sections IV and VI, respectively. When the samples were taken over 6, 12, or 18 hour collection periods, a 24 hour concentration value was calculated by flow proportioning the data from the individual samples.

TAP WATER

Organics (μg/L)

SAMPLE	3	12	38	51				Avg.
Methylene chloride	14	2	–	–				
1,1-Dichloroethylene	–	–	–	–				–
Chloroform	43	36	41	38				40
1,2-Dichloroethane	–	–	–	–				–
1,1,1-Trichloroethane	–	–	–	–				–
Bromodichloromethane	3	3	32	29				17
Dibromochloromethane	12	16	16	16				15
Chlorobenzene	–	–	–	–				–
Benzene	–	–	–	–				–
Ethyl Benzene	–	1	–	–				0.2
Bromoform	–	1	3	3				2
1,1,2,2-Tetrachloroethylene	–	–	–	–				–
1,1,2,2-Tetrachloroethane	–	–	–	–				–
Toluene	–	–	–	–				–
Trans-1,2-dichloroethylene	–	–	–	–				–
Phenol	–	–	–	–				–
2,4-Dimethylphenol	–	–	–	–				–
Pentachlorophenol	–	–	–	–				–
Naphthalene	–	–	–	–				–
Diethyl phthalate	–	13	–	–				3
Di-n-butyl phthalate	–	36	21	–				14
Bis(2-ethylhexyl)phthalate	–	54	12	–				16
Butyl benzyl phthalate	–	–	–	–				–
Anthracene/Phenanthrene	–	–	–	–				–
Dichlorobenzenes	–	–	–	–				–
Heptachlor	–	–	–	–				–

TAP WATER

Metals, Cyanides and Phenols (μg/L)

SAMPLE NUMBER	3	12	38	51				Avg.
Silver	4	–	–	–				1
Arsenic	–	6	14	5				6
Beryllium	–	–	–	–				–
Cadmium	–	–	8	–				2
Chromium	40	–	–	–				10
Copper	37	40	35	–				28
Mercury	–	–	–	–				–
Manganese	16	14	–	–				7
Nickel	52	–	–	–				13
Lead	–	–	–	–				–
Antimony	–	–	–	–				–
Selenium	–	3	8	6				4
Thallium	–	–	–	–				–
Zinc	110	–	18	47				44
Total Cyanides	–	–	–	–				–
Total Phenols	11	21	–	–				8

TAP WATER

Classical Wastewater Parameters (mg/L)

SAMPLE NUMBER	3	12	38	51				Avg.
pH	8.0	8.0	6.5	6.3				7.2
T (°C)	24.5	25.0	23.9	24.2				24.4
Ammonia	0.25	0.1	0.1	0.1				0.1
Oil and Grease	-	-	-	-				-
TSS	-	-	-	5				1.3
TOC	5	3	4	5				4.3
COD	-	-	-	-				-
BOD	-	-	-	-				-

POTW INFLUENT

Organics (μg/L)

SAMPLE	2	11	23	30	43	56		Avg.
Methylene chloride	62	24	>100	–	1	14		
1,1-Dichloroethylene	–	–	–	–	–	–		–
Chloroform	2	3	2	5	2	2		3
1,2-Dichloroethane	3	–	–	–	–	–		0.5
1,1,1-Trichloroethane	1	1	–	–	–	–		0.3
Bromodichloromethane	–	–	–	–	–	–		–
Dibromochloromethane	–	–	–	–	–	–		–
Chlorobenzene	–	–	–	–	–	–		–
Benzene	4	4	4	2	4	4		4
Ethyl Benzene	2	2	2	–	–	–		1
Bromoform	–	–	–	–	–	–		–
1,1,2,2-Tetrachloroethylene	–	–	1	–	3	2		1
1,1,2,2-Tetrachloroethane	–	–	5	–	–	–		1
Toluene	11	2	–	–	–	–		2
Trans-1,2-dichloroethylene	–	–	–	–	–	–		–
Phenol	–	–	–	–	–	–		–
2,4-Dimethylphenol	–	–	–	–	–	–		–
Pentachlorophenol	–	26	–	–	–	–		4
Naphthalene	12	–	14	–	–	–		4
Diethyl phthalate	13	–	22	13	21	–		12
Di-n-butyl phthalate	16	–	26	–	16	17		12
Bis(2-ethylhexyl)phthalate	–	15	–	–	11	–		4
Butyl benzyl phthalate	–	–	–	–	–	–		–
Anthracene/Phenanthrene	–	–	–	–	–	–		–
Dichlorobenzenes	–	–	–	–	–	–		–
Heptachlor	–	–	–	–	3	–		0.5

POTW INFLUENT

Metals, Cyanides and Phenols (μg/L)

SAMPLE NUMBER	2	11	23	30	43	56		Avg.
Silver	5	5	4	5	2	2		4
Arsenic	33	29	35	14	14	12		23
Beryllium	–	–	–	–	–	–		–
Cadmium	3	4	4	–	4	–		2
Chromium	130	–	430	250	140	–		158
Copper	87	65	130	72	33	12		66
Mercury	–	–	–	–	2	–		0.3
Manganese	380	350	410	310	310	320		347
Nickel	36	–	92	98	27	–		42
Lead	22	18	49	18	13	–		20
Antimony	–	–	–	–	–	–		–
Selenium	–	4	–	8	11	9		5
Thallium	–	–	–	–	–	–		–
Zinc	530	350	660	430	230	150		392

Total Cyanides	100	28	–	90	–	30		41

Total Phenols	27	13	27	30	22	29		25

POTW INFLUENT

Classical Wastewater Parameters (mg/L)

SAMPLE NUMBER	2	11	23	30	43	56		Avg.
pH	7.5	7.4	7.4	6.8	6.1	6.0		6.9
T (°C)	22.1	22.8	22.3	22.9	22.7	22.8		22.6
Ammonia	18	12	12	12	15	14		13.8
Oil and Grease	Lost	125	115	20	25	30		63.0
TSS	70	80	150	40	110	170		103
TOC	–	38	43	48	56	62		49.4
COD	–	120	250	190	180	190		186
BOD	25	40	55	50	60	50		48.3

KIRKRIDGE

Organics (μg/L)

SAMPLE	1	10	24	53	64			Avg.
Methylene chloride	LOST	–	–	–	–			
1,1-Dichloroethylene		–	–	–	–			–
Chloroform		2	2	2	2			2
1,2-Dichloroethane		–	–	–	–			–
1,1,1-Trichloroethane		–	–	–	–			–
Bromodichloromethane		–	–	–	–			–
Dibromochloromethane		–	–	–	–			–
Chlorobenzene		–	–	–	–			–
Benzene		–	–	–	–			–
Ethyl Benzene		1	–	–	–			0.2
Bromoform		–	–	–	–			–
1,1,2,2-Tetrachloroethylene		–	–	1	1			0.5
1,1,2,2-Tetrachloroethane		–	–	–	–			–
Toluene		–	–	3	–			0.8
Trans-1,2-dichloroethylene		–	–	–	–			–
Phenol	–	–	10	–	–			2
2,4-Dimethylphenol	–	–	–	–	–			–
Pentachlorophenol	–	–	–	–	–			–
Naphthalene	–	–	–	–	–			–
Diethyl phthalate	–	18	28	35	14			19
Di-n-butyl phthalate	–	–	17	–	77			19
Bis(2-ethylhexyl)phthalate	–	22	–	–	12			7
Butyl benzyl phthalate	–	–	–	–	36			7
Anthracene/Phenanthrene	–	–	–	–	–			–
Dichlorobenzenes	–	–	–	–	–			–
Heptachlor	–	–	–	–	–			–

KIRKRIDGE

Metals, Cyanides and Phenols (μg/L)

SAMPLE NUMBER	1	10	24	53	64			Avg.
Silver	-	2	2	-	-			1
Arsenic	21	30	32	6	8			19
Beryllium	-	-	-	-	-			-
Cadmium	-	-	-	-	-			-
Chromium	33	-	-	-	-			7
Copper	110	80	180	140	210			144
Mercury	-	-	-	-	-			-
Manganese	110	94	45	73	81			81
Nickel	-	-	-	-	-			-
Lead	12	-	14	-	-			5
Antimony	-	-	-	-	-			-
Selenium	-	-	-	9	12			4
Thallium	-	-	-	-	-			-
Zinc	140	94	140	120	160			131

Total Cyanides	-	-	-	-	-			-

Total Phenols	41	36	33	-	30			28

KIRKRIDGE

Classical Wastewater Parameters (mg/L)

SAMPLE NUMBER	1	10	24	53	64			Avg.
pH	7.4	7.7	8.2	6.2	6.5			7.2
T (°C)	21.8	21.9	21.4	21.2	21.6			21.6
Ammonia	23	34	18	21	23			23.8
Oil and Grease	115	Lost	50	45	45			63.8
TSS	120	100	160	200	200			156
TOC	63	72	64	120	140			91.8
COD	150	375	250	340	300			283
BOD	100	70	125	145	165			121

ST. GEORGE

Organics (µg/L)

SAMPLE	39	52						Avg.
Methylene chloride	–	–						–
1,1-Dichloroethylene	–	–						–
Chloroform	13	10						12
1,2-Dichloroethane	–	–						–
1,1,1-Trichloroethane	–	–						–
Bromodichloromethane	11	8						10
Dibromochloromethane	8	6						7
Chlorobenzene	–	–						–
Benzene	–	2						1
Ethyl Benzene	–	–						–
Bromoform	3	–						2
1,1,2,2-Tetrachloroethylene	–	1						0.5
1,1,2,2-Tetrachloroethane	–	–						–
Toluene	–	–						–
Trans-1,2-dichloroethylene	–	–						–
Phenol	–	–						–
2,4-Dimethylphenol	–	–						–
Pentachlorophenol	–	11						6
Naphthalene	–	–						–
Diethyl phthalate	–	10						5
Di-n-butyl phthalate	83	4						44
Bis(2-ethylhexyl)phthalate	10	47						28
Butyl benzyl phthalate	–	–						–
Anthracene/Phenanthrene	–	–						–
Dichlorobenzenes	–	–						–
Heptachlor	–	–						–

ST. GEORGE

Metals, Cyanides and Phenols (µg/L)

SAMPLE NUMBER	39	52						Avg.
Silver	12	18						15
Arsenic	8	–						4
Beryllium	–	–						–
Cadmium	–	–						–
Chromium	–	–						–
Copper	660	810						735
Mercury	–	–						–
Manganese	17	38						27
Nickel	–	–						–
Lead	20	170						95
Antimony	–	–						–
Selenium	13	9						11
Thallium	–	–						–
Zinc	87	300						193
Total Cyanides	–	–						–
Total Phenols	72	35						53

ST. GEORGE

Classical Wastewater Parameters (mg/L)

SAMPLE NUMBER	39	52						Avg.
pH	7.8	9.0						8.4
T (°C)	32.6	31.0						31.8
Ammonia	0.85	<5						< 3
Oil and Grease	15	20						17.5
TSS	30	190						110
TOC	32	1000						540
COD	80	2700						1400
BOD	40	1300						670

ELCO

Organics (µg/L)

SAMPLE	4/5	13/14	21/22	31	44	57		Avg.
Methylene chloride	-	26	40	20	-	-		
1,1-Dichloroethylene	-	-	-	-	-	-		-
Chloroform	3	1	4	2	3	2		3
1,2-Dichloroethane	-	-	-	-	-	-		-
1,1,1-Trichloroethane	-	-	4	-	-	-		0.7
Bromodichloromethane	-	-	1	-	-	-		0.2
Dibromochloromethane	-	-	1	-	-	-		0.2
Chlorobenzene	-	-	6	-	-	-		1
Benzene	-	-	-	-	1	-		0.2
Ethyl Benzene	2	1	11	-	-	-		2
Bromoform	-	-	-	-	-	-		-
1,1,2,2-Tetrachloroethylene	-	-	13	1	2	-		3
1,1,2,2-Tetrachloroethane	-	-	-	-	-	3		0.5
Toluene	2	1	8	-	-	22		6
Trans-1,2-dichloroethylene	-	-	-	-	-	-		-
Phenol	18	12	12	21	35	20		20
2,4-Dimethylphenol	-	4	-	-	-	-		0.7
Pentachlorophenol	-	-	-	-	-	-		-
Naphthalene	-	10	-	-	-	-		2
Diethyl phthalate	2	32	15	86	38	12		31
Di-n-butyl phthalate	-	-	16	15	-	49		13
Bis(2-ethylhexyl)phthalate	14	14	14	20	13	-		12
Butyl benzyl phthalate	-	-	-	25	13	-		6
Anthracene/Phenanthrene	-	-	-	-	-	-		-
Dichlorobenzenes	-	-	-	-	-	-		-
Heptachlor	-	-	-	-	-	-		-

ELCO

Metals, Cyanides and Phenols (µg/L)

SAMPLE NUMBER	4/5	13/14	21/22	31	44	57		Avg.
Silver	-	-	1	-	-	-		0.2
Arsenic	10	12	30	8	24	11		16
Beryllium	-	-	-	-	-	-		-
Cadmium	-	-	5	-	-	-		1
Chromium	-	-	-	77	-	23		17
Copper	103	152	144	87	55	99		107
Mercury	2	-	-	-	-	-		0.3
Manganese	59	220	297	110	56	50		132
Nickel	2	29	31	-	-	-		10
Lead	44	44	81	37	22	70		51
Antimony	9	-	-	8	-	-		3
Selenium	5	4	2	2	-	25		6
Thallium	-	-	-	-	-	-		-
Zinc	144	111	169	120	110	150		134

Total Cyanides	-	-	-	-	-	-		-

Total Phenols	59	81	41	70	32	62		58

ELCO

Classical Wastewater Parameters (mg/L)

SAMPLE NUMBER	4/5	13/14	21/22	31	44	57		Avg.
pH	8.4	8.9	8.9	6.4	6.2	6.4		7.5
T (^{o}C)	23.7	24.4	23.6	22.7	22.5	22.8		23.3
Ammonia	24	20	17	21	23	26		21.8
Oil and Grease	44	1900	22	55	55	30		351
TSS	120	670	1200	220	170	40		403
TOC	120	65	55	130	105	120		99.2
COD	310	240	220	380	410	350		318
BOD	140	100	68	185	220	195		151

DELFAIR

Organics (μg/L)

SAMPLE	8/9	17/18	27/28	34/35	47/48	60/61		Avg.
Methylene chloride	21	100	28	21	36	–		
1,1-Dichloroethylene	–	–	–	–	–	–		–
Chloroform	5	6	5	7	7	6		6
1,2-Dichloroethane	–	–	–	–	–	–		–
1,1,1-Trichloroethane	–	–	–	–	5	4		2
Bromodichloromethane	–	2	2	4	2	3		2
Dibromochloromethane	–	–	–	3	3	3		2
Chlorobenzene	–	–	–	–	–	–		–
Benzene	–	–	–	1	1	1		0.5
Ethyl Benzene	2	2	13	–	–	–		3
Bromoform	–	–	–	–	–	–		–
1,1,2,2-Tetrachloroethylene	1	12	7	10	8	4		7
1,1,2,2-Tetrachloroethane	–	–	–	–	–	–		–
Toluene	3	2	25	1	2	1		6
Trans-1,2-dichloroethylene	–	1	1	–	–	–		0.3
Phenol	–	10	10	–	11	–		5
2,4-Dimethylphenol	–	–	–	–	–	–		–
Pentachlorophenol	–	–	–	–	–	–		–
Naphthalene	–	–	6	–	–	–		1
Diethyl phthalate	–	20	16	36	–	6		13
Di-n-butyl phthalate	–	32	16	28	68	75		36
Bis(2-ethylhexyl)phthalate	5	24	12	16	77	7		24
Butyl benzyl phthalate	–	–	–	12	56	13		14
Anthracene/Phenanthrene	–	–	–	–	–	–		–
Dichlorobenzenes	–	–	–	16	–	–		3
Heptachlor	–	–	–	–	–	–		–

DELFAIR

Metals, Cyanides and Phenols (µg/L)

SAMPLE NUMBER	8/9	17/18	27/28	34/35	47/48	60/61		Avg.
Silver	1	7	–	–	3	–		2
Arsenic	6	11	14	6	8	10		9
Beryllium	–	–	–	–	–	–		–
Cadmium	–	–	–	–	13	–		2
Chromium	–	–	–	–	–	–		–
Copper	34	54	40	26	40	24		36
Mercury	–	–	–	–	–	–		–
Manganese	582	522	492	405	363	380		457
Nickel	8	–	16	16	40	11		15
Lead	5	7	4	–	–	–		3
Antimony	13	–	–	–	–	–		2
Selenium	2	4	2	8	5	8		5
Thallium	–	–	–	–	1	1		0.3
Zinc	100	122	148	94	210	173		141

Total Cyanides	–	–	–	–	–	–		–

Total Phenols	34	26	51	42	48	22		37

DELFAIR

Classical Wastewater Parameters (mg/L)

SAMPLE NUMBER	8/9	17/18	27/28	34/35	47/48	60/61		Avg.
pH	7.7	7.5	7.5	7.3	7.2	7.4		7.5
T (°C)	22.6	22.9	22.8	24.8	25.2	25.7		24.0
Ammonia	14	16	15	14	15	12		14
Oil and Grease	2000	41	150	28	51	45		386
TSS	130	76	170	120	180	120		133
TOC	55	76	83	84	104	95		82.8
COD	200	280	280	220	300	250		255
BOD	100	80	120	90	150	100		107

WEST BOURNE

Organics (μg/L)

SAMPLE	6/7	15/16	25/26	32/33	45/46	58/59		Avg.*
Methylene chloride	23	4	9	–	5	2		
1,1-Dichloroethylene	–	–	–	–	–	–		–
Chloroform	6	5	3	3	5	4		4
1,2-Dichloroethane	–	–	4	–	–	–		0.7
1,1,1-Trichloroethane	12	4	4	1	–	2		4
Bromodichloromethane	–	–	2	1	2	2		1
Dibromochloromethane	1	–	–	–	1	2		0.7
Chlorobenzene	–	–	–	–	–	–		–
Benzene	2	–	>100/0	6	7	2		3
Ethyl Benzene	3	3	>100/0	4	13	–		4
Bromoform	–	–	–	–	–	–		–
1,1,2,2-Tetrachloroethylene	2	2	3	4	2	4		3
1,1,2,2-Tetrachloroethane	–	–	–	–	–	–		–
Toluene	17	2	>100/0	30	57	2		18
Trans-1,2-dichloroethylene	–	–	–	–	–	–		–
Phenol	6	–	–	8	10	–		4
2,4-Dimethylphenol	–	–	–	–	–	–		–
Pentachlorophenol	–	–	–	–	–	–		–
Naphthalene	–	7	150/0	–	8	–		3
Diethyl phthalate	25	30	29	7	16	–		16
Di-n-butyl phthalate	18	30	41	28	–	–		20
Bis(2-ethylhexyl)phthalate	26	31	6	13	14	–		15
Butyl benzyl phthalate	12	6	–	19	–	–		6
Anthracene/Phenanthrene	–	–	15/0	–	–	–		–
Dichlorobenzenes	–	–	–	–	–	–		–
Heptachlor	–	–	–	–	1	1		0.3

*High values of 25 excluded from average.

WEST BOURNE

Metals, Cyanides and Phenols (µg/L)

SAMPLE NUMBER	6/7	15/16	25/26	32/33	45/46	58/59		Avg.
Silver	2	2	1	–	1	–		1
Arsenic	8	9	12	9	10	2		8
Beryllium	–	–	–	–	–	–		–
Cadmium	2	6	6	–	–	–		2
Chromium	–	–	–	–	–	–		–
Copper	44	67	88	32	90	40		60
Mercury	–	–	2	–	–	–		0.3
Manganese	288	296	400	324	292	324		320
Nickel	25	56	–	39	21	11		25
Lead	19	23	76	28	44	22		35
Antimony	–	–	–	–	–	–		–
Selenium	–	–	–	1	3	4		1
Thallium	–	–	2	–	1	–		0.5
Zinc	194	136	150	106	166	98		142
Total Cyanides	–	–	–	–	–	–		–
Total Phenols	33	34	40	34	39	35		36

WEST BOURNE

Classical Wastewater Parameters (mg/L)

SAMPLE NUMBER	6/7	15/16	25/26	32/33	45/46	58/59		Avg.
pH	7.5	7.4	7.6	7.1	7.1	7.2		7.3
T (°C)	25.0	25.4	24.7	25.4	25.7	24.6		25.1
Ammonia	17	17	15	13	13	15		15.0
Oil and Grease	35	630	15	31	45	47		134
TSS	76	70	220	120	170	130		131
TOC	63	52	41	76	100	88		70.0
COD	220	200	130	270	340	260		237
BOD	74	85	47	100	140	110		92.7

SYLVED

Organics (μg/L)

SAMPLE	36/37	49/50	62/63					Avg.
Methylene chloride	–	12	–					
1,1-Dichloroethylene	–	–	–					–
Chloroform	3	3	2					3
1,2-Dichloroethane	–	–	–					–
1,1,1-Trichloroethane	–	–	–					–
Bromodichloromethane	–	–	–					–
Dibromochloromethane	–	–	–					–
Chlorobenzene	–	–	–					–
Benzene	–	–	–					–
Ethyl Benzene	–	–	–					–
Bromoform	–	–	–					–
1,1,2,2-Tetrachloroethylene	3	4	2					3
1,1,2,2-Tetrachloroethane	–	–	–					–
Toluene	2	2	–					1
Trans-1,2-dichloroethylene	–	–	–					–
Phenol	–	–	–					–
2,4-Dimethylphenol	–	–	–					–
Pentachlorophenol	–	–	–					–
Naphthalene	–	–	–					–
Diethyl phthalate	18	6	–					8
Di-n-butyl phthalate	4	9	21					11
Bis(2-ethylhexyl)phthalate	11	6	–					6
Butyl benzyl phthalate	–	–	–					–
Anthracene/Phenanthrene	–	–	–					–
Dichlorobenzenes	24	–	–					8
Heptachlor	–	–	–					–

SYLVED

Metals, Cyanides and Phenols (μg/L)

SAMPLE NUMBER	36/37	49/50	62/63					Avg.
Silver	–	8	–					3
Arsenic	11	13	17					14
Beryllium	–	–	–					–
Cadmium	–	2	–					1
Chromium	–	–	–					–
Copper	50	39	27					39
Mercury	–	–	–					–
Manganese	347	370	384					367
Nickel	27	12	–					13
Lead	6	14	4					8
Antimony	–	–	4					1
Selenium	14	11	8					11
Thallium	–	–	–					–
Zinc	231	127	114					157

Total Cyanides	–	–	–					–

Total Phenols	38	23	19					27

SYLVED

Classical Wastewater Parameters (mg/L)

SAMPLE NUMBER	36/37	49/50	62/63					Avg.
pH	7.3	7.5	7.4					7.4
T (^oC)	23.2	23.0	22.6					22.9
Ammonia	9	11	14					11.3
Oil and Grease	19	23	26					22.7
TSS	88	95	82					88.3
TOC	75	67	69					70.3
COD	160	200	190					183
BOD	89	65	55					69.7

APPENDIX G

Analytical Data by Chemical Compound

This appendix contains all of the analytical data for Cincinnati organized by chemical compound. Only the compounds observed above the reporting limit at least once have been included. All of the other priority pollutants were not detected, with the exception of asbestos for which the samples were not analyzed. All of the concentration data have been given for 24 hour periods. When the samples were taken over 6, 12, or 18 hour collection periods, a 24 hour value was calculated by flow proportioning and time weighing the data for the individual samples.

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106 METHYLENE CHLORIDE
                                                                          AVERAGE
SITES                                                                      WHEN              PERCENT
                         TUES      WED    THURS      FRI      SAT      SUN  PRESENT  AVERAGE  PRESENT
S KIRKRIDGE                          0        0                 0        0       .0       .0       00
O DELFAIR                  22       56       30       22       35        0     32.9     27.5       83
U ELCO                      0       26       40       20        0        0     28.6     14.3       50
R WEST BOURNE              24        4       10        0        5        1      8.9      7.4       83
C SYLVED                                                0       11        0     11.1      3.7       33
E ST GEORGE                                             0        0                 .0       .0       00
S
-  TAP WATER               14        2                 0        0                8.0      4.0       50

   POTW INFLUENT           62       24      101        0        1       14     40.4     33.7       83

AVERAGE
  WHEN                   23.0     28.5     26.6     20.8     17.3      1.2     21.9
PRESENT
(ALL SOURCES)

AVERAGE                  15.4     21.4     19.9      8.3      8.6       .2              11.3

PERCENT
PRESENT                    67       75       75       40       50       20                         52
**************************************************************************************************
112 TRANS-1,2-DICHLOROETHYLENE
                                                                          AVERAGE
SITES                                                                      WHEN              PERCENT
                         TUES      WED    THURS      FRI      SAT      SUN  PRESENT  AVERAGE  PRESENT
S KIRKRIDGE                          0        0                 0        0       .0       .0       00
O DELFAIR                   0        1        1        0        0        0      1.0       .3       33
U ELCO                      0        0        0        0        0        0       .0       .0       00
R WEST BOURNE               0        0        0        0        0        0       .0       .0       00
C SYLVED                                                0        0        0       .0       .0       00
E ST GEORGE                                             0        0                 .0       .0       00
S
-  TAP WATER                0        0                 0        0                 .0       .0       00

   POTW INFLUENT            0        0        0        0        0        0       .0       .0       00

AVERAGE
  WHEN                     .0      1.0      1.0       .0       .0       .0      1.0
PRESENT
(ALL SOURCES)

AVERAGE                    .0       .3       .3       .0       .0       .0                .1

PERCENT
PRESENT                    00       25       25       00       00       00                         07
**************************************************************************************************
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113 CHLOROFURM                                                         AVERAGE
                                                                        WHEN               PERCENT
SITES           TUES     WED     THURS     FRI     SAT     SUN       PRESENT   AVERAGE    PRESENT
S KIRKRIDGE               2        2                2       2          2.0       2.0       1 00
O DELFAIR        5        6        5        7       7       6          6.0       6.0       1 00
U ELCO           3        1        5        2       3       2          2.7       2.7       1 00
R WEST BOURNE    6        5        3        3       5       4          4.2       4.2       1 00
C SYLVED                                    3       2       2          2.4       2.4       1 00
E ST GEORGE                                13      10                 11.5      11.5       1 00
S
- TAP WATER     43       36                41      38                 39.5      39.5       1 00

  POTW INFLUENT  2        3        2        5       2       2          2.7       2.7       1 00

AVERAGE
  WHEN          4.5      3.4      3.8      5.5     4.9     3.2         4.3
PRESENT
(ALL SOURCES)

AVERAGE         4.5      3.4      3.8      5.5     4.9     3.2                   4.3

PERCENT
PRESENT        1 00     1 00     1 00     1 00    1 00    1 00                            1 00
***************************************************************************************************
114 1.2-DICHLOROETHANE                                                 AVERAGE
                                                                        WHEN               PERCENT
SITES           TUES     WED     THURS     FRI     SAT     SUN       PRESENT   AVERAGE    PRESENT
S KIRKRIDGE               0        0                0       0           .0        .0         00
O DELFAIR        0        0        0        0       0       0           .0        .0         00
U ELCO           0        0        0        0       0       0           .0        .0         00
R WEST BOURNE    0        0        4        0       0       0          3.8        .6         17
C SYLVED                                    0       0       0           .0        .0         00
E ST GEORGE                                 0       0                   .0        .0         00
S
- TAP WATER      0        0                 0       0                   .0        .0         00

  POTW INFLUENT  3        0        0        0       0       0          3.0        .5         17

AVERAGE
  WHEN           .0       .0      3.8       .0      .0      .0         3.8
PRESENT
(ALL SOURCES)

AVERAGE          .0       .0      1.0       .0      .0      .0                    .1

PERCENT
PRESENT          00       00       25       00      00      00                              04
***************************************************************************************************
```

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115 1.1.1-TRICHLOROETHANE

SITES                                                              AVERAGE
                                                                    WHEN                PERCENT
                    TUES    WED   THURS    FRI     SAT     SUN    PRESENT   AVERAGE    PRESENT
S KIRKRIDGE                   0      0               0       0       .0        .0          00
O DELFAIR             0       0      0       0       5       4      4.7       1.6          33
U ELCO                0       0      3       0       0       0      2.6        .4          17
R WEST BOURNE        12       4      4       1       1       2      3.9       3.9        1 00
C SYLVED                                     0       0       0       .0        .0          00
E ST GEORGE                                  0       0               .0        .0          00
S
-  TAP WATER          0       0              0       0               .0        .0          00

   POTW INFLUENT      1       1      0       0       0       0      1.0        .3          33

AVERAGE
  WHEN
PRESENT            12.0     4.0    3.5      .6     2.9     3.0      3.9
(ALL SOURCES)

AVERAGE             4.0     1.0    1.8      .1     1.0     1.2                1.3

PERCENT
PRESENT              33      25     50      12      33      40                             33
*****************************************************************************************
117 BROMODICHLOROMETHANE

SITES                                                              AVERAGE
                                                                    WHEN                PERCENT
                    TUES    WED   THURS    FRI     SAT     SUN    PRESENT   AVERAGE    PRESENT
S KIRKRIDGE                   0      0               0       0       .0        .0          00
O DELFAIR             0       2      2       4       2       3      2.6       2.2          83
U ELCO                0       0      2       0       0       0      1.7        .3          17
R WEST BOURNE         0       0      2       1       2       2      1.6       1.1          67
C SYLVED_                                    0       0       0       .0        .0          00
E ST GEORGE                                 11       8              9.5       9.5        1 00
S
-  TAP WATER          3       3             32      29             16.8      16.8        1 00

   POTW INFLUENT      0       0      0       0       0       0       .0        .0          00

AVERAGE
  WHEN
PRESENT              .0     2.0    1.8     5.1     4.0     2.7      3.3
(ALL SOURCES)

AVERAGE              .0      .5    1.3     3.1     2.0     1.1                1.5

PERCENT
PRESENT              00      25     75      60      50      40                             44
*****************************************************************************************
```

```
121 BENZENE
                                                                          AVERAGE
SITES                                                                      WHEN               PERCENT
                  TUES     WED    THURS      FRI      SAT      SUN     PRESENT  AVERAGE   PRESENT
S KIRKRIDGE                  0        0                 0        0          .0       .0        00
O DELFAIR            0       0        0        1        1        1          .8       .4        42
U ELCO               0       0        0        0        1        0         1.0       .2        17
R WEST BOURNE        2       0       65        6        7        2        16.2     13.5        83
C SYLVED                                       0        0        0          .0       .0        00
E ST GEORGE                                    0        2                  2.0      1.0        50
S
- TAP WATER          0       0                 0        0                   .0       .0        00

  POTW INFLUENT      4       4        4        2        4        4         3.7      3.7      1 00

AVERAGE
  WHEN             1.8      .0     64.6      3.5      2.7      1.1         8.6
PRESENT
(ALL SOURCES)

AVERAGE             .6      .0     16.1      1.4      1.8       .4                  3.2

PERCENT
PRESENT             33      00       25       40       67       40                              37
**************************************************************************************************
123 DIBROMOCHLOROMETHANE
                                                                          AVERAGE
SITES                                                                      WHEN               PERCENT
                  TUES     WED    THURS      FRI      SAT      SUN     PRESENT  AVERAGE   PRESENT
S KIRKRIDGE                  0        0                 0        0          .0       .0        00
O DELFAIR            0       0        0        3        3        3         3.0      1.5        50
U ELCO               0       0        1        0        0        0          .8       .1        14
R WEST BOURNE        1       0        0        0        1        1         1.0       .7        67
C SYLVED                                       0        0        0          .5       .2        15
E ST GEORGE                                    8        6                  7.0      7.0      1 00
S
- TAP WATER         12      16                16       16                 15.0     15.0      1 00

  POTW INFLUENT      0       0        0        0        0        0          .0       .0        00

AVERAGE
  WHEN             1.4      .0       .8      3.8      2.6      2.2         2.6
PRESENT
(ALL SOURCES)

AVERAGE             .5      .0       .2      2.3      1.7       .9                  1.1

PERCENT
PRESENT             33      00       21       60       67       40                              41
**************************************************************************************************
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125 BROMOFORM
                                                                           AVERAGE
SITES                                                                        WHEN              PERCENT
                          TUES      WED     THURS       FRI       SAT       SUN  PRESENT  AVERAGE  PRESENT
S KIRKRIDGE                           0         0                   0         0       .0       .0       00
O DELFAIR                    0        0         0         0         0         0       .0       .0       00
U ELCO                       0        0         0         0         0         0       .0       .0       00
R WEST BOURNE                0        0         0         0         0         0       .0       .0       00
C SYLVED                                                  0         0         0       .0       .0       00
E ST GEORGE                                               3         0                3.0      1.5       50
S
- TAP WATER                  0        1                   3         3                2.3      1.8       75

  POTW INFLUENT              0        0         0         0         0         0       .0       .0       00

AVERAGE
  WHEN                      .0       .0        .0       3.0        .0        .0      3.0
PRESENT
(ALL SOURCES)

AVERAGE                     .0       .0        .0        .6        .0        .0                .1

PERCENT
PRESENT                     00       00        00        20        00        00                         04
*******************************************************************************************************
126 1,1,2,2-TETRACHLOROETHANE
                                                                           AVERAGE
SITES                                                                        WHEN              PERCENT
                          TUES      WED     THURS       FRI       SAT       SUN  PRESENT  AVERAGE  PRESENT
S KIRKRIDGE                           0         0                   0         0       .0       .0       00
O DELFAIR                    0        0         0         0         0         0       .0       .0       00
U ELCO                       0        0         0         0         0         3      3.0       .5       17
R WEST BOURNE                0        0         0         0         0         0       .0       .0       00
C SYLVED                                                  0         0         0       .0       .0       00
E ST GEORGE                                               0         0                 .0       .0       00
S
- TAP WATER                  0        0                   0         0                 .0       .0       00

  POTW INFLUENT              0        0         5         0         0         0      5.0       .8       17

AVERAGE
  WHEN                      .0       .0        .0        .0        .0       3.0      3.0
PRESENT
(ALL SOURCES)

AVERAGE                     .0       .0        .0        .0        .0        .6                .1

PERCENT
PRESENT                     00       00        00        00        00        20                         04
*******************************************************************************************************
```

```
127 1.1.2.2-TETRACHLOROETHYLEN
                                                                          AVERAGE
SITES                                                                      WHEN               PERCENT
                   TUES      WED     THURS      FRI       SAT       SUN   PRESENT  AVERAGE    PRESENT
S KIRKRIDGE                    0         0                  1         1     1.0        .5         50
O DELFAIR             1       11         7        9         8         4     6.8       6.8       1 00
U ELCO                0        0        12        1         2         0     4.9       2.5         50
R WEST BOURNE         2        2         3        4         3         4     2.8       2.8       1 00
C SYLVED                                          3         3         2     2.6       2.6       1 00
E ST GEORGE                                       0         1               1.0        .5         50
S
- TAP WATER           0        0                  0         0                .0        .0         00

  POTW INFLUENT       0        0         1        0         3         2     2.0       1.0         50

AVERAGE
  WHEN              1.4      6.4       7.4      4.2       3.1       2.7     4.0
PRESENT
(ALL SOURCES)

AVERAGE              .9      3.2       5.5      3.3       3.1       2.1               3.1

PERCENT
PRESENT              67       50        75       80      1 00        80                           78
***********************************************************************************************************
128 TOLUENE
                                                                          AVERAGE
SITES                                                                      WHEN               PERCENT
                   TUES      WED     THURS      FRI       SAT       SUN   PRESENT  AVERAGE    PRESENT
S KIRKRIDGE                    0         0                  3         0     3.0        .8         25
O DELFAIR             3        2        26        1         3         1     6.0       6.0       1 00
U ELCO                2        2         4        0         0        22     7.4       4.9         67
R WEST BOURNE        17        2        65       30        56         2    28.6      28.6       1 00
C SYLVED                                          2         2         1     1.6       1.6       1 00
E ST GEORGE                                       0         0                .0        .0         00
S
- TAP WATER           0        0                  0         0                .0        .0         00

  POTW INFLUENT      11        2         0        0         0         0     6.5       2.2         33

AVERAGE
  WHEN              7.4      1.9      31.4     11.2      15.9       6.4    12.2
PRESENT
(ALL SOURCES)

AVERAGE             7.4      1.4      23.6      6.7      10.6       5.1               9.1

PERCENT
PRESENT            1 00       75        75       60        67        80                           74
***********************************************************************************************************
```

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129 CHLUROBENZENE
                                                                             AVERAGE
SITES                                                                          WHEN               PERCENT
                         TUES       WED     THURS       FRI       SAT       SUN    PRESENT  AVERAGE   PRESENT
S KIRKRIDGE                           0         0                   0         0        .0       .0       00
O DELFAIR                   0         0         0         0         0         0        .0       .0       00
U ELCO                      0         0         3         0         0         0       2.6       .4       17
R WEST BOURNE               0         0         0         0         0         0        .0       .0       00
C SYLVED                                                  0         0         0        .0       .0       00
E ST GEORGE                                               0         0                  .0       .0       00
S
-  TAP WATER                0         0                   0         0                  .0       .0       00

   POTW INFLUENT            0         0         0         0         0         0        .0       .0       00

AVERAGE
  WHEN                     .0        .0       2.6        .0        .0        .0       2.6
PRESENT
(ALL SOURCES)

AVERAGE                    .0        .0        .6        .0        .0        .0                 .1

PERCENT
PRESENT                    00        00        25        00        00        00                          04
*****************************************************************************************************
130 ETHYL BENZENE
                                                                             AVERAGE
SITES                                                                          WHEN               PERCENT
                         TUES       WED     THURS       FRI       SAT       SUN    PRESENT  AVERAGE   PRESENT
S KIRKRIDGE                           1         0                   0         0       1.0       .3       25
O DELFAIR                   2         2        13         0         0         0       5.8      2.9       50
U ELCO                      2         0         6         0         0         0       2.8      1.4       50
R WEST BOURNE               3         3        65         5        13         0      17.6     14.7       83
C SYLVED                                                  0         0         0        .0       .0       00
E ST GEORGE                                               0         0                  .0       .0       00
S
-  TAP WATER                0         1                   0         0                 1.0       .3       25

   POTW INFLUENT            2         2         2         0         0         0       2.0      1.0       50

AVERAGE
  WHEN                    2.3       1.6      28.0       4.8      13.0        .0       9.6
PRESENT
(ALL SOURCES)

AVERAGE                   2.3       1.6      21.0       1.0       2.2        .0                4.3

PERCENT
PRESENT                  1 00      1 00        75        20        17        00                          44
*****************************************************************************************************
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203 PHENOL
                                                                          AVERAGE
SITES                                                                      WHEN                PERCENT
                     TUES      WED     THURS       FRI       SAT       SUN   PRESENT  AVERAGE   PRESENT
S KIRKRIDGE            0         0       10                    0         0     10.0      2.0       20
O DELFAIR              0         9       10          0        11         0     10.2      5.1       50
U ELCO                19        17       16         21        35        20     21.3     21.3     1 00
R WEST BOURNE          6         0        0          8        11         0      8.3      4.1       50
C SYLVED                                             0         0         0       .0       .0       00
E ST GEORGE                                          0         0                 .0       .0       00
S
- TAP WATER            0         0                   0         0                 .0       .0       00

  POTW INFLUENT        0         0        0          0         0         0       .0       .0       00

AVERAGE
 WHEN               12.6      12.9     12.1       14.7      18.9      20.0     14.9
PRESENT
(ALL SOURCES)

AVERAGE              6.3       6.5      9.1        5.9       9.4       4.0               6.9

PERCENT
PRESENT               50        50       75         40        50        20                         46
*********************************************************************************************************
204 2.4-DIMETHYLPHENOL
                                                                          AVERAGE
SITES                                                                      WHEN                PERCENT
                     TUES      WED     THURS       FRI       SAT       SUN   PRESENT  AVERAGE   PRESENT
S KIRKRIDGE            0         0        0                    0         0       .0       .0       00
O DELFAIR              0         0        0          0         0         0       .0       .0       00
U ELCO                 0         8        0          0         0         0      8.3      1.4       17
R WEST BOURNE          0         0        0          0         0         0       .0       .0       00
C SYLVED                                             0         0         0       .0       .0       00
E ST GEORGE                                          0         0                 .0       .0       00
S
- TAP WATER            0         0                   0         0                 .0       .0       00

  POTW INFLUENT        0         0        0          0         0         0       .0       .0       00

AVERAGE
 WHEN                 .0       8.3       .0         .0        .0        .0      8.3
PRESENT
(ALL SOURCES)

AVERAGE               .0       2.1       .0         .0        .0        .0                .3

PERCENT
PRESENT               00        25       00         00        00        00                         04
*********************************************************************************************************
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210 PENTACHLOROPHENOL
                                                                                AVERAGE
SITES                                                                             WHEN                PERCENT
                        TUES        WED      THURS       FRI        SAT        SUN  PRESENT  AVERAGE  PRESENT
S KIRKRIDGE               0          0          0                     0          0       .0       .0       00
O DELFAIR                 0          0          0          0          0          0       .0       .0       00
U ELCO                    0          0          0          0          0          0       .0       .0       00
R WEST BOURNE             0          0          0          0          0          0       .0       .0       00
C SYLVED                                                   0          0          0       .0       .0       00
E ST GEORGE                                                0         11                11.0      5.5       50
S
-  TAP WATER              0          0                     0          0                  .0       .0       00

   POTW INFLUENT          0         26          0          0          0          0     26.0      4.3       17

AVERAGE
  WHEN                   .0         .0         .0         .0       11.0         .0     11.0
PRESENT
(ALL SOURCES)

AVERAGE                  .0         .0         .0         .0        1.8         .0                .4

PERCENT
PRESENT                  00         00         00         00         17         00                         04
*****************************************************************************************************************
301 DICHLOROBENZENES
                                                                                AVERAGE
SITES                                                                             WHEN                PERCENT
                        TUES        WED      THURS       FRI        SAT        SUN  PRESENT  AVERAGE  PRESENT
S KIRKRIDGE               0          0          0                     0          0       .0       .0       00
O DELFAIR                 0          0          0         15          0          0     15.0      2.5       17
U ELCO                    0          0          0          0          0          0       .0       .0       00
R WEST BOURNE             0          0          0          0          0          0       .0       .0       00
C SYLVED                                                  23          0          0     22.6      7.5       33
E ST GEORGE                                                0          0                  .0       .0       00
S
-  TAP WATER              0          0                     0          0                  .0       .0       00

   POTW INFLUENT          0          0          0          0          0          0       .0       .0       00

AVERAGE
  WHEN                   .0         .0         .0       18.8         .0         .0     18.8
PRESENT
(ALL SOURCES)

AVERAGE                  .0         .0         .0        7.5         .0         .0               1.3

PERCENT
PRESENT                  00         00         00         40         00         00                         07
*****************************************************************************************************************
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337 BUTYL BENZYL PHTHALATE
                                                                                AVERAGE
                                                                                 WHEN                PERCENT
SITES                                                                    SUN   PRESENT   AVERAGE    PRESENT
                       TUES       WED     THURS       FRI       SAT
S KIRKRIDGE               0         0         0                   0       36      36.0       7.2         20
O DELFAIR                 0         0         0        12        59       12      27.7      13.8         50
U ELCO                    0         0         0        25        13        0      19.0       6.3         33
R WEST BOURNE            12         6         0        14         0        0      14.0       2.3         17
C SYLVED                                                0         0        0        .0        .0         00
E ST GEORGE                                             0         0                 .0        .0         00
S
- TAP WATER               0         0                   0         0                 .0        .0         00

  POTW INFLUENT           0         0         0         0         0        0        .0        .0         00

AVERAGE
 WHEN                  12.0       6.5        .0      17.0      36.0     24.0      19.1
PRESENT
(ALL SOURCES)

AVERAGE                 3.0       1.6        .0      10.2      12.0      9.6                 6.1

PERCENT
PRESENT                  25        25        00        60        33       40                             31
*************************************************************************************************************
338 BIS(2-ETHYLHEXYL)PHTHALATE
                                                                                AVERAGE
                                                                                 WHEN                PERCENT
SITES                                                                    SUN   PRESENT   AVERAGE    PRESENT
                       TUES       WED     THURS       FRI       SAT
S KIRKRIDGE               0        22         0                   0       12      17.0       6.8         40
O DELFAIR                 5        24        12        15        79        6      23.7      23.7       1 00
U ELCO                   15        20        19        20        13        0      17.5      14.6         83
R WEST BOURNE            26        31         7        13        14        0      18.3      15.3         83
C SYLVED                                               11         6        0       8.4       5.6         67
E ST GEORGE                                            10        47               28.5      28.5       1 00
S
- TAP WATER               0        54                  12         0               33.0      16.5         50

  POTW INFLUENT           0        15         0         0        11        0      13.0       4.3         33

AVERAGE
 WHEN                  15.8      24.2      12.9      13.9      31.7      9.2      19.5
PRESENT
(ALL SOURCES)

AVERAGE                11.8      24.2       9.7      13.9      26.4      3.7                15.3

PERCENT
PRESENT                  75      1 00        75      1 00        83       40                             79
*************************************************************************************************************
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331 ANTHRACENE/PHENANTHRENE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	PERCENT PRESENT
S	KIRKRIDGE	0	0	0		0	0	.0	.0	00
O	DELFAIR	0	0	0	0	0	0	.0	.0	00
U	ELCO	0	0	0	0	0	0	.0	.0	00
R	WEST BOURNE	0	0	10	0	0	0	9.6	1.6	17
C	SYLVED				0	0	0	.0	.0	00
E	ST GEORGE				0	0		.0	.0	00
S										
-	TAP WATER	0	0		0	0		.0	.0	00
	POTW INFLUENT	0	0	0	0	0	0	.0	.0	00
	AVERAGE WHEN PRESENT (ALL SOURCES)	.0	.0	9.6	.0	.0	.0	9.6		
	AVERAGE	.0	.0	2.4	.0	.0	.0		.3	
	PERCENT PRESENT	00	00	25	00	00	00			04

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333 DI-N-BUTYL PHTHALATE

	SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	PERCENT PRESENT
S	KIRKRIDGE	0	0	17		0	77	47.0	18.8	40
O	DELFAIR	0	31	16	28	71	73	43.7	36.4	83
U	ELCO	0	0	12	15	0	49	25.4	12.7	50
R	WEST BOURNE	18	30	42	28	0	0	29.5	19.7	67
C	SYLVED				4	8	21	11.2	11.2	1 00
E	ST GEORGE				83	4		43.5	43.5	1 00
S										
-	TAP WATER	0	36		21	0		28.5	14.3	50
	POTW INFLUENT	16	0	26	0	16	17	18.8	12.5	67
	AVERAGE WHEN PRESENT (ALL SOURCES)	17.7	30.3	21.8	31.6	27.9	55.1	33.0		
	AVERAGE	4.4	15.2	21.8	31.6	13.9	44.1		22.4	
	PERCENT PRESENT	25	50	1 00	1 00	50	80			68

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315 NAPHTHALENE
                                                                                AVERAGE
SITES                                                                            WHEN                PERCENT
                         TUES       WED     THURS       FRI       SAT       SUN   PRESENT  AVERAGE    PRESENT
S KIRKRIDGE                0          0         0                   0         0      .0       .0          00
O DELFAIR                  0          0         7         0         0         0     7.1      1.2          17
U ELCO                     0         14         0         0         0         0    14.0      2.3          17
R WEST BOURNE              0          7        96         0         8         0    36.7     18.3          50
C SYLVED                                                  0         0         0      .0       .0          00
E ST GEORGE                                               0         0                .0       .0          00
S
- TAP WATER                0          0                   0         0                .0       .0          00

  POTW INFLUENT           12          0        14         0         0         0    13.0      4.3          33

AVERAGE
 WHEN                     .0       10.3      51.5        .0       7.5        .0    26.2
PRESENT
(ALL SOURCES)

AVERAGE                   .0        5.1      25.7        .0       1.3        .0              4.7

PERCENT
PRESENT                   00         50        50        00        17        00                           18
**********************************************************************************************************
326 DIETHYL PHTHALATE
                                                                                AVERAGE
SITES                                                                            WHEN                PERCENT
                         TUES       WED     THURS       FRI       SAT       SUN   PRESENT  AVERAGE    PRESENT
S KIRKRIDGE                0         18        28                  35        14    23.8     19.0          80
O DELFAIR                  0         19        17        35         0         5    19.2     12.8          67
U ELCO                     1         14         6        86        38        12    26.1     26.1        1 00
R WEST BOURNE             25         31        30         7        16         0    21.7     18.1          83
C SYLVED                                                 18         6         0    12.4      8.3          67
E ST GEORGE                                               0        10              10.0      5.0          50
S
- TAP WATER                0         13                   0         0              13.0      3.3          25

  POTW INFLUENT           13          0        22        13        21         0    17.3     11.5          67

AVERAGE
 WHEN                   12.8       20.4      20.3      36.7      21.0      10.4    21.4
PRESENT
(ALL SOURCES)

AVERAGE                  6.4       20.4      20.3      29.4      17.5       6.2             16.8

PERCENT
PRESENT                   50       1 00      1 00        80        83        60                           79
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501 ANTIMONY
                                                                          AVERAGE
SITES                                                                      WHEN             PERCENT
                  TUES      WED     THURS      FRI      SAT      SUN   PRESENT  AVERAGE  PRESENT
S KIRKRIDGE          0        0        0                 0        0        .0       .0       00
O DELFAIR           14        0        0         0       0        0      13.8      2.3       17
U ELCO               9        0        0         8       0        0       8.3      2.8       33
R WEST BOURNE        0        0        0         0       0        0        .0       .0       00
C SYLVED                                         0       0        4       3.9      1.3       33
E ST GEORGE                                      0       0                 .0       .0       00
S
- TAP WATER          0        0                  0       0                 .0       .0       00

  POTW INFLUENT      0        0        0         0       0        0        .0       .0       00

AVERAGE
  WHEN            11.2       .0       .0       8.0      .0      3.9       8.6
PRESENT
(ALL SOURCES)

AVERAGE            5.6       .0       .0       1.6      .0       .8                1.2

PERCENT
PRESENT             50       00       00        20      00       20                          14
*************************************************************************************************
502 ARSENIC
                                                                          AVERAGE
SITES                                                                      WHEN             PERCENT
                  TUES      WED     THURS      FRI      SAT      SUN   PRESENT  AVERAGE  PRESENT
S KIRKRIDGE         21       30       32                 6        8      21.4     21.4     1 00
O DELFAIR            6       11       14         5       8       10       9.1      9.1     1 00
U ELCO              11       14       36         8      24       11      17.3     17.3     1 00
R WEST BOURNE        8        9       12         8       9        2       8.4      8.4     1 00
C SYLVED                                        11      14       17      13.8     13.8     1 00
E ST GEORGE                                      8       0                8.0      4.0       50
S
- TAP WATER          0        6                 14       5                8.3      6.3       75

  POTW INFLUENT     33       29       35        14      14       12      22.8     22.8     1 00

AVERAGE
  WHEN            11.4     16.2     23.6       8.1    12.2     11.6      13.5
PRESENT
(ALL SOURCES)

AVERAGE           11.4     16.2     23.6       8.1    10.2     11.6               13.0

PERCENT
PRESENT           1 00     1 00     1 00      1 00      83     1 00                          96
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503 BERYLLIUM
                                                                          AVERAGE
SITES                                                                      WHEN                PERCENT
                     TUES      WED    THURS      FRI      SAT      SUN   PRESENT  AVERAGE    PRESENT
S KIRKRIDGE             0        0        0                 0        0       .0       .0         00
O DELFAIR               0        0        0        0        0        0       .0       .0         00
U ELCO                  0        0        0        0        0        0       .0       .0         00
R WEST BOURNE           0        0        0        0        0        0       .0       .0         00
C SYLVED                                           0        0        0       .0       .0         00
E ST GEORGE                                        0        0                .0       .0         00
S
- TAP WATER             0        0                 0        0                .0       .0         00

  POTW INFLUENT         0        0        0        0        0        0       .0       .0         00

AVERAGE
 WHEN                  .0       .0       .0       .0       .0       .0       .0
PRESENT
(ALL SOURCES)

AVERAGE                .0       .0       .0       .0       .0       .0                .0

PERCENT
PRESENT                00       00       00       00       00       00                           00
******************************************************************************************************
504 CADMIUM
                                                                          AVERAGE
SITES                                                                      WHEN                PERCENT
                     TUES      WED    THURS      FRI      SAT      SUN   PRESENT  AVERAGE    PRESENT
S KIRKRIDGE             0        0        0                 0        0       .0       .0         00
O DELFAIR               0        0        0        0       13        0     13.0      2.2         17
U ELCO                  0        0        7        0        0        0      6.7      1.1         17
R WEST BOURNE           2        6        6        0        0        0      4.7      2.3         50
C SYLVED                                           0        2        0      1.8       .6         33
E ST GEORGE                                        0        0                .0       .0         00
S
- TAP WATER             0        0                 8        0               8.0      2.0         25

  POTW INFLUENT         3        4        4        0        4        0      3.8      2.5         67

AVERAGE
 WHEN                 2.3      6.0      6.2       .0      7.4       .0      5.9
PRESENT
(ALL SOURCES)

AVERAGE                .6      1.5      3.1       .0      2.5       .0               1.3

PERCENT
PRESENT                25       25       50       00       33       00                           21
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505 CHROMIUM
                                                                                     AVERAGE
SITES                                                                                   WHEN              PERCENT
                            TUES       WED     THURS       FRI       SAT       SUN   PRESENT   AVERAGE   PRESENT
S KIRKRIDGE                   33         0         0                   0         0      33.0       6.6        20
O DELFAIR                      0         0         0         0         0         0        .0        .0        00
U ELCO                         0         0         0        77         0        23      50.0      16.7        33
R WEST BOURNE                  0         0         0         0         0         0        .0        .0        00
C SYLVED                                                     0         0         0        .0        .0        00
E ST GEORGE                                                  0         0                  .0        .0        00
S
- TAP WATER                   40         0                   0         0                40.0      10.0        25

  POTW INFLUENT              130         0       430       250       140         0     237.5     158.3        67

AVERAGE
  WHEN                      33.0        .0        .0      77.0        .0      23.0      44.3
PRESENT
(ALL SOURCES)

AVERAGE                      8.3        .0        .0      15.4        .0       4.6                 4.8

PERCENT
PRESENT                       25        00        00        20        00        20                            11
*****************************************************************************************************************
506 COPPER
                                                                                     AVERAGE
SITES                                                                                   WHEN              PERCENT
                            TUES       WED     THURS       FRI       SAT       SUN   PRESENT   AVERAGE   PRESENT
S KIRKRIDGE                  110        80       180                 140       210     144.0     144.0      1 00
O DELFAIR                     33        56        40        26        40        24      36.3      36.3      1 00
U ELCO                       108       168       154        87        55        99     111.7     111.7      1 00
R WEST BOURNE                 44        67        88        31        88        40      59.8      59.8      1 00
C SYLVED                                                    49        39        27      38.2      38.2      1 00
E ST GEORGE                                                660       810               735.0     735.0      1 00
S
- TAP WATER                   37        40                  35         0                37.3      28.0        75

  POTW INFLUENT               87        65       130        72        33        12      66.5      66.5      1 00

AVERAGE
  WHEN                      73.6      92.8     115.2     170.6     195.3      80.0     126.8
PRESENT
(ALL SOURCES)

AVERAGE                     73.6      92.8     115.2     170.6     195.3      80.0               126.8

PERCENT
PRESENT                     1 00      1 00      1 00      1 00      1 00      1 00                          1 00
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507 LEAD                                                                        AVERAGE
                                                                                 WHEN                 PERCENT
SITES              TUES      WED      THURS      FRI      SAT       SUN      PRESENT   AVERAGE     PRESENT
S KIRKRIDGE          12        0         14                 0         0        13.0       5.2          40
O DELFAIR             5        8          4        0        0         0         5.4       2.7          50
U ELCO               46       53        110       37       22        76        57.4      57.4        1 00
R WEST BOURNE        19       23         81       28       43        22        35.8      35.8        1 00
C SYLVED                                           5       13         4         7.7       7.7        1 00
E ST GEORGE                                       20      170                  95.0      95.0        1 00
S
- TAP WATER           0        0                   0        0                    .0        .0          00

  POTW INFLUENT      22       18         49       18       13         0        24.0      20.0          83

AVERAGE
 WHEN              20.3     27.8       52.2     22.5     62.2      34.0        37.0
PRESENT
(ALL SOURCES)

AVERAGE            20.3     20.8       52.2     18.0     41.4      20.4                  29.1

PERCENT
PRESENT            1 00       75       1 00       80       67        60                                79
****************************************************************************************************
508 MANGANESE                                                                   AVERAGE
                                                                                 WHEN                 PERCENT
SITES              TUES      WED      THURS      FRI      SAT       SUN      PRESENT   AVERAGE     PRESENT
S KIRKRIDGE         110       94         45                73        81        80.6      80.6        1 00
O DELFAIR           583      528        487      407      365       380       458.2     458.2        1 00
U ELCO               62      287        593      110       56        50       192.9     192.9        1 00
R WEST BOURNE       287      296        402      324      294       324       321.1     321.1        1 00
C SYLVED                                         347      371       384       367.1     367.1        1 00
E ST GEORGE                                       17       38                  27.5      27.5        1 00
S
- TAP WATER          16       14                   0        0                  15.0       7.5          50

  POTW INFLUENT     380      350        410      310      310       320       346.7     346.7        1 00

AVERAGE
 WHEN             260.2    301.4      381.6    240.9    199.4     243.8       264.0
PRESENT
(ALL SOURCES)

AVERAGE           260.2    301.4      381.6    240.9    199.4     243.8                 264.0

PERCENT
PRESENT            1 00     1 00       1 00     1 00     1 00      1 00                              1 00
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509 MERCURY                                                              AVERAGE
                                                                          WHEN             PERCENT
SITES                  TUES      WED    THURS      FRI      SAT      SUN  PRESENT  AVERAGE  PRESENT
S KIRKRIDGE               0        0        0                 0        0       .0       .0       00
O DELFAIR                 0        0        0        0        0        0       .0       .0       00
U ELCO                    2        0        0        0        0        0      1.9       .3       17
R WEST BOURNE             0        0        2        0        0        0      2.0       .3       17
C SYLVED                                             0        0        0       .0       .0       00
E ST GEORGE                                          0        0                .0       .0       00
S
- TAP WATER               0        0                 0        0                .0       .0       00

  POTW INFLUENT           0        0        0        0        2        0      2.0       .3       17

AVERAGE                 1.9       .0      2.0       .0       .0       .0      2.0
  WHEN
PRESENT
(ALL SOURCES)

AVERAGE                  .5       .0       .5       .0       .0       .0                .1

PERCENT
PRESENT                  25       00       25       00       00       00                         07
******************************************************************************************************
510 NICKEL                                                               AVERAGE
                                                                          WHEN             PERCENT
SITES                  TUES      WED    THURS      FRI      SAT      SUN  PRESENT  AVERAGE  PRESENT
S KIRKRIDGE               0        0        0                 0        0       .0       .0       00
O DELFAIR                 8        0       15       16       40       11     17.8     14.9       83
U ELCO                    1       23       43        0        0        0     22.2     11.1       50
R WEST BOURNE            26       55        0       39       21       11     30.5     25.4       83
C SYLVED                                            25       12        0     18.5     12.4       67
E ST GEORGE                                          0        0                .0       .0       00
S
- TAP WATER              52        0                 0        0              52.0     13.0       25

  POTW INFLUENT          36        0       92       98       27        0     63.3     42.2       67

AVERAGE                11.4     39.3     28.8     26.6     24.3     11.0     23.0
  WHEN
PRESENT
(ALL SOURCES)

AVERAGE                 8.6     19.7     14.4     16.0     12.1      4.4              12.3

PERCENT
PRESENT                  75       50       50       60       50       40                         54
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511 SELENIUM
                                                                           AVERAGE
SITES                                                                        WHEN           PERCENT
                        TUES      WED    THURS      FRI      SAT      SUN  PRESENT  AVERAGE  PRESENT
S KIRKRIDGE                0        0        0                 9       12     10.5      4.2       40
O DELFAIR                  3        5        2        9        5        8      5.3      5.3     1 00
U ELCO                     6        4        1        2        0       25      7.7      6.4       83
R WEST BOURNE              0        0        0        1        3        4      2.4      1.2       50
C SYLVED                                             15       11        8     11.2     11.2     1 00
E ST GEORGE                                          13        9               11.0     11.0     1 00
S
- TAP WATER                0        3                 8        6                5.7      4.3       75

  POTW INFLUENT            0        4        0        8       11        9      8.0      5.3       67

AVERAGE
  WHEN                   4.6      4.6      1.4      7.8      7.3     11.4      7.3
PRESENT
(ALL SOURCES)

AVERAGE                  2.3      2.3       .7      7.8      6.1     11.4               5.5

PERCENT
PRESENT                   50       50       50     1 00       83     1 00                          75
****************************************************************************************************
512 SILVER
                                                                           AVERAGE
SITES                                                                        WHEN           PERCENT
                        TUES      WED    THURS      FRI      SAT      SUN  PRESENT  AVERAGE  PRESENT
S KIRKRIDGE                0        2        2                 0        0      2.0       .8       40
O DELFAIR                  1        7        0        0        3        0      3.5      1.7       50
U ELCO                     0        1        2        0        0        0      1.3       .4       33
R WEST BOURNE              2        2        1        0        1        0      1.8      1.2       67
C SYLVED                                              0        8        0      7.8      2.6       33
E ST GEORGE                                          12       18               15.0     15.0     1 00
S
- TAP WATER                4        0                 0        0                4.0      1.0       25

  POTW INFLUENT            5        5        4        5        2        2      3.8      3.8     1 00

AVERAGE
  WHEN                   1.8      2.9      1.7     12.0      7.5       .0      4.4
PRESENT
(ALL SOURCES)

AVERAGE                   .9      2.9      1.2      2.4      5.0       .0               2.2

PERCENT
PRESENT                   50     1 00       75       20       67       00                          50
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513 THALLIUM
                                                                               AVERAGE
SITES                                                                           WHEN              PERCENT
                 TUES      WED     THURS      FRI       SAT       SUN    PRESENT  AVERAGE  PRESENT
S KIRKRIDGF        0         0         0                  0         0        .0       .0       00
O DELFAIR          0         0         0        0         1         1        .7       .3       34
U ELCO             0         0         0        0         0         0        .0       .0       00
R WEST BOURNE      0         0         3        0         1         0       1.2       .6       50
C SYLVED                                        0         0         0        .0       .0       00
E ST GEORGE                                     0         0                  .0       .0       00
S
- TAP WATER        0         0                  0         0                  .0       .0       00

  POTW INFLUENT    0         0         0        0         0         0        .0       .0       00

AVERAGE
  WHEN            .0        .0       2.6       .4        .7        .9        .9
PRESENT
(ALL SOURCES)

AVERAGE           .0        .0        .6       .2        .2        .2                 .2

PERCENT
PRESENT           00        00        25       18        22        18                          20
*********************************************************************************************************
514 ZINC
                                                                               AVERAGE
SITES                                                                           WHEN              PERCENT
                 TUES      WED     THURS      FRI       SAT       SUN    PRESENT  AVERAGE  PRESENT
S KIRKRIDGE      140        94       140                120       160     130.8    130.8     1 00
O DELFAIR         99       118       145       93       212       166     138.8    138.8     1 00
U ELCO           154       116       212      120       110       150     143.7    143.7     1 00
R WEST BOURNE    196       136       160      106       165        98     143.3    143.3     1 00
C SYLVED                                      230       124       114     156.0    156.0     1 00
E ST GEORGE                                    87       300               193.5    193.5     1 00
S
- TAP WATER      110         0                 18        47                58.3     43.8       75

  POTW INFLUENT  530       350       660      430       230       150     391.7    391.7     1 00

AVERAGE
  WHEN         147.2     115.1     164.1    127.2     171.7     137.6     145.1
PRESENT
(ALL SOURCES)

AVERAGE        147.2     116.1     164.1    127.2     171.7     137.6              145.1

PERCENT
PRESENT         1 00      1 00      1 00     1 00      1 00      1 00                        1 00
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601 TOTAL CYANIDES
                                                                  AVERAGE
SITES                                                              WHEN               PERCENT
                     TUES     WED    THURS      FRI      SAT      SUN  PRESENT  AVERAGE  PRESENT
S KIRKRIDGE             0       0        0                 0        0       .0       .0       00
O DELFAIR               0       0        0        0        0        0       .0       .0       00
U ELCO                  0       0        0        0        0        0       .0       .0       00
R WEST BOURNE           0       0        0        0        0        0       .0       .0       00
C SYLVED                                          0        0        0       .0       .0       00
E ST GEORGE                                       0        0                .0       .0       00
S
- TAP WATER             0       0                 0        0                .0       .0       00

  POTW INFLUENT       100      28        0       90        0       30     62.0     41.3       67

AVERAGE
  WHEN                 .0      .0       .0       .0       .0       .0       .0
PRESENT
(ALL SOURCES)

AVERAGE                .0      .0       .0       .0       .0       .0                .0

PERCENT
PRESENT                00      00       00       00       00       00                         00
***********************************************************************************************
602 TOTAL PHENOLS
                                                                  AVERAGE
SITES                                                              WHEN               PERCENT
                     TUES     WED    THURS      FRI      SAT      SUN  PRESENT  AVERAGE  PRESENT
S KIRKRIDGE            41      36       33                 0       30     35.0     28.0       80
O DELFAIR              34      26       51       42       48       23     37.3     37.3     1 00
U ELCO                 63      81       41       70       32       62     58.2     58.2     1 00
R WEST BOURNE          34      33       40       34       39       35     35.9     35.9     1 00
C SYLVED                                         37       23       18     26.1     26.1     1 00
E ST GEORGE                                      72       35              53.5     53.5     1 00
S
- TAP WATER            11      21                 0        0              16.0      8.0       50

  POTW INFLUENT        27      13       27       30       22       29     24.7     24.7     1 00

AVERAGE
  WHEN               42.9    44.2     41.3     51.1     35.3     33.7     41.3
PRESENT
(ALL SOURCES)

AVERAGE              42.9    44.2     41.3     51.1     29.5     33.7              39.8

PERCENT
PRESENT              1 00    1 00     1 00     1 00       83     1 00                         96
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701 PH
                                                                      AVERAGE
SITES                                                                   WHEN                 PERCENT
                     TUES       WED     THURS       FRI       SAT       SUN   PRESENT  AVERAGE   PRESENT
S KIRKRIDGE             7         8         8                   6         7       7.2      7.2     1 00
O DELFAIR               8         8         7         7         7         7       7.4      7.4     1 00
U ELCO                  8         9         9         6         6         6       7.6      7.6     1 00
R WEST BOURNE           8         7         8         7         7         7       7.3      7.3     1 00
C SYLVED                                              7         8         7       7.4      7.4     1 00
E ST GEORGE                                           8         9                 8.4      8.4     1 00
S
- TAP WATER             8         8                   7         6                 7.2      7.2     1 00

  POTW INFLUENT         8         7         7         7         6         6       6.9      6.9     1 00

AVERAGE
  WHEN                7.8       8.0       8.0       7.2       7.2       7.0       7.5
PRESENT
(ALL SOURCES)

AVERAGE               7.8       8.0       8.0       7.2       7.2       7.0                7.5

PERCENT
PRESENT              1 00      1 00      1 00      1 00      1 00      1 00                          1 00
**********************************************************************************************************
702 T( C)
                                                                      AVERAGE
SITES                                                                   WHEN                 PERCENT
                     TUES       WED     THURS       FRI       SAT       SUN   PRESENT  AVERAGE   PRESENT
S KIRKRIDGE            22        22        21                  21        22      21.6     21.6     1 00
O DELFAIR              23        23        23        25        25        26      24.0     24.0     1 00
U ELCO                 24        25        24        23        23        23      23.5     23.5     1 00
R WEST BOURNE          25        25        25        25        26        25      25.1     25.1     1 00
C SYLVED                                             23        23        23      23.0     23.0     1 00
E ST GEORGE                                          33        31                31.8     31.8     1 00
S
- TAP WATER            25        25                  24        24                24.4     24.4     1 00

  PUTW INFLUENT        22        23        22        23        23        23      22.6     22.6     1 00

AVERAGE
  WHEN               23.3      23.7      23.3      25.7      24.8      23.4      24.1
PRESENT
(ALL SOURCES)

AVERAGE              23.3      23.7      23.3      25.7      24.8      23.4               24.1

PERCENT
PRESENT              1 00      1 00      1 00      1 00      1 00      1 00                          1 00
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703 AMMONIA
                                                                              AVERAGE
SITES                                                                           WHEN                PERCENT
                         TUES        WED      THURS        FRI        SAT        SUN   PRESENT  AVERAGE  PRESENT
S KIRKRIDGE               23         34         18                     21         23      23.8     23.8    1 00
O DELFAIR                 14         16         15         13         15         12      14.3     14.3    1 00
U ELCO                    23         16         14         21         23         26      20.5     20.5    1 00
R WEST BOURNE             17         17         15         13         13         15      15.1     15.1    1 00
C SYLVED                                                    9         11         14      11.3     11.3    1 00
E ST GEORGE                                                 1          5                  2.9      2.9    1 00
S
- TAP WATER                0          0                     0          0                   .1       .1      14

  POTW INFLUENT           18         12         12         12         15         14      13.8     13.8    1 00

AVERAGE
  WHEN                  19.4       20.8       15.4       11.3       14.7       18.2      16.4
PRESENT
(ALL SOURCES)

AVERAGE                 19.4       20.8       15.4       11.3       14.7       18.2               16.4

PERCENT
PRESENT                 1 00       1 00       1 00       1 00       1 00       1 00                       1 00
*****************************************************************************************************************
704 OIL AND GREASE
                                                                              AVERAGE
SITES                                                                           WHEN                PERCENT
                         TUES        WED      THURS        FRI        SAT        SUN   PRESENT  AVERAGE  PRESENT
S KIRKRIDGE              115          0         50                     45         45      63.8     51.0      80
O DELFAIR               1954         41        156         27         51         45     379.0    379.0    1 00
U ELCO                    35        327         27         35         55         30      84.8     84.8    1 00
R WEST BOURNE             35        633         10         31         45         47     133.4    133.4    1 00
C SYLVED                                                   18         22         26      22.2     22.2    1 00
E ST GEORGE                                                15         20                 17.5     17.5    1 00
S
- TAP WATER                0          0                     5          5                  5.0      2.5      50

  POTW INFLUENT            0        125        115         20         25         30      63.0     52.5      83

AVERAGE
  WHEN                 534.8      333.5       60.6       25.3       39.7       38.5     145.9
PRESENT
(ALL SOURCES)

AVERAGE                534.8      250.1       60.6       25.3       39.7       38.5              140.7

PERCENT
PRESENT                 1 00         75       1 00       1 00       1 00       1 00                         96
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705 TBS

SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	PERCENT PRESENT
S KIRKRIDGE	120	100	160		200	200	156.0	156.0	1 00
O DELFAIR	127	76	167	114	175	118	129.4	129.4	1 00
U ELCO	127	889	1636	220	170	40	513.6	513.6	1 00
R WEST BOURNE	77	70	225	118	167	130	131.0	131.0	1 00
C SYLVED				87	92	82	87.0	87.0	1 00
E ST GEORGE				30	190		110.0	110.0	1 00
S									
- TAP WATER	0	0		5	5		5.0	2.5	50
POTW INFLUENT	70	80	150	40	110	170	103.3	103.3	1 00
AVERAGE WHEN PRESENT (ALL SOURCES)	112.7	283.5	547.0	113.6	165.8	114.0	210.9		
AVERAGE	112.7	283.5	547.0	113.6	165.8	114.0		210.9	
PERCENT PRESENT	1 00	1 00	1 00	1 00	1 00	1 00			1 00

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706 TOC

SITES	TUES	WED	THURS	FRI	SAT	SUN	AVERAGE WHEN PRESENT	AVERAGE	PERCENT PRESENT
S KIRKRIDGE	63	72	64		120	140	91.8	91.8	1 00
O DELFAIR	55	75	84	83	103	93	82.4	82.4	1 00
U ELCO	128	70	59	130	105	120	101.8	101.8	1 00
R WEST BOURNE	64	52	42	76	101	88	70.3	70.3	1 00
C SYLVED				75	66	69	70.2	70.2	1 00
E ST GEORGE				32	1040		536.0	536.0	1 00
S									
- TAP WATER	5	3		4	5		4.3	4.3	1 00
POTW INFLUENT	0	38	43	48	56	62	49.4	41.2	83
AVERAGE WHEN PRESENT (ALL SOURCES)	77.4	67.2	62.0	79.3	255.9	102.1	116.7		
AVERAGE	77.4	67.2	62.0	79.3	255.9	102.1		116.7	
PERCENT PRESENT	1 00	1 00	1 00	1 00	1 00	1 00			1 00

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707 COD
                                                                      AVERAGE
SITES                                                                   WHEN                    PERCENT
                    TUES     WED     THURS     FRI      SAT      SUN  PRESENT   AVERAGE    PRESENT
S KIRKRIDGE          150     375      250               340      300    283.0     283.0       1 00
O DELFAIR            200     274      282      220      299      249    254.2     254.2       1 00
U ELCO               323     280      254      380      410      350    333.0     333.0       1 00
R WEST BOURNE        219     196      129      268      335      258    234.1     234.1       1 00
C SYLVED                                       161      203      188    184.1     184.1       1 00
E ST GEORGE                                     80     2700            1390.0    1390.0       1 00
S
- TAP WATER            0       0                10       10              10.0       5.0         50

  POTW INFLUENT        0     120      250      190      180      190    186.0     155.0         83

AVERAGE
  WHEN             223.1   281.3    228.9    221.9    714.5    269.0    345.5
PRESENT
(ALL SOURCES)

AVERAGE            223.1   281.3    228.9    221.9    714.5    269.0              345.5

PERCENT
PRESENT             1 00    1 00     1 00     1 00     1 00     1 00                          1 00
******************************************************************************************************
708 BOD                                                               AVERAGE
                                                                        WHEN                    PERCENT
SITES               TUES     WED     THURS     FRI      SAT      SUN  PRESENT   AVERAGE    PRESENT
S KIRKRIDGL          100      70      125               145      165    121.0     121.0       1 00
O DELFAIR            102      80      120       89      153      100    107.2     107.2       1 00
U ELCO               142     117       81      185      220      195    156.7     156.7       1 00
R WEST BOURNE         74      85       47      102      136      112     92.7      92.7       1 00
C SYLVED                                        88       65       55     69.3      69.3       1 00
E ST GEORGE                                     40     1250             645.0     645.0       1 00
S
- TAP WATER            0       0                 5        5               5.0       2.5         50

  POTW INFLUENT       35      40       55       50       60       50     48.3      48.3       1 00

AVERAGE
  WHEN             104.5    87.9     93.2    100.8    328.1    125.4    151.5
PRESENT
(ALL SOURCES)

AVERAGE            104.5    87.9     93.2    100.8    328.1    125.4              151.5

PERCENT
PRESENT             1 00    1 00     1 00     1 00     1 00     1 00                          1 00
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*U.S. GOVERNMENT PRINTING OFFICE:1981   341-082/144   1-3